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Madhu Rao et al.

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For: NEIGHBOR DISCOVERY USING ADDRESS REGISTRATION PROTOCOL OVER ELMI

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CERTIFICATE OF MAILING

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DECLARATION OF MADHU ROA UNDER 37 C.F.R. §1.132

I, Madhu Rao, declare as follows:

1. I am one of the inventors of the above-identified patent application that has been assigned to Cisco Technology, Inc. I have been employed by Cisco Systems, Inc. of San Jose, California from May 25, 1999 through the present. Cisco Systems, Inc. is the parent corporation of Cisco Technology, Inc.

2. The declaration is made herein to establish derivation of the relevant subject matter of the cited publication, "Cisco Publication: Frame Relay ELMI Address Registration" by Cisco, posted on December 6, 2000 (hereinafter "Cisco Document") from the applicants rather than being invented by the author of the Cisco Document

which has been attached as Exhibit A.

3. Exhibit B is the Office Action dated June 6, 2007 of the above-referenced application. This Office Action describes the relevant subject matter of Exhibit A.

4. The documentation process to generate configuration and product guides (e.g., Cisco Document) at Cisco Technology, Inc is as follows. Inventors provide functional and design specifications for a product to documentation writers. Based on the functional and design specifications, the documentation writers generate the configuration and product guides. Engineering teams that include the inventors review and approve these configuration and product guides. These configuration and product guides are then published and provided to customers.

5. Exhibit C is an ELMI Protocol Document entitled "IP Address/ IfIndex Registration Using ELMI protocol on the UFM Card" (hereinafter "ELMI Protocol Document"). The relevant dates have been redacted from Exhibit C. I authored the ELMI Protocol Document. Srikanthkumar Hosakote and I invented the relevant subject matter of the ELMI Protocol Document. The preparation of the above-referenced application was based on the ELMI Protocol Document which was prepared and dated prior to December 6, 2000.

6. Srikanthkumar Hosakote and I provided the ELMI Protocol Document to the documentation writers at Cisco Systems, Inc. Upon information and belief, Max Anderson was the documentation person who authored the Cisco Document, Exhibit A, per page 7 of the ELMI-Address registration Program Plan (EDCS-49176) which has been attached as Exhibit D. The relevant dates have been redacted from Exhibit D. Max Anderson is not currently employed at Cisco Systems, Inc.

7. I hereby declare that the relevant subject matter of the Cisco Document was derived from the ELMI Protocol Document that was provided to Max Anderson. Max Anderson did not invent the relevant subject matter of the Cisco Document. Non-relevant subject matter of the Cisco Document was derived from other source(s) provided to Max Anderson. The relevant subject matter of the Cisco Document should be attributed to the applicants, Srikanthkumar Hosakote, and myself.

8. I have reviewed the application, including the claims of the application. I have also reviewed a copy of the claims set forth in Exhibit E, which are the pending claims that include amendments made by an amendment accompanying my Declaration. Prior to December 6, 2000, Srikanthkumar Hosakote and I conceived of the invention, and that invention is set forth in the claims of Exhibit E.

9. Attached as Exhibit F is an Invention Disclosure Document entitled "Neighbor Discovery Using Address Registration protocol running over ELMI" (hereinafter "Invention Disclosure Document") describing embodiments of the claimed invention. The relevant dates have been redacted from Exhibit F. The Invention Disclosure Document discusses advantages of implementing the ELMI-AR protocol on the UFM frame relay card and neighbor Cisco IOS. The Invention Disclosure Document further discusses how Cisco products that provide network management solutions will use the ELMI-AR feature to provide complete network discovery.

10. I hereby declare that my invention was conceived prior to December 6, 2000. The Invention Disclosure Document was completed prior to December 6, 2000, and submitted to the Legal Department of Cisco Technology, Inc. Exhibit F demonstrates that the claimed invention was conceived of prior to December 6, 2000.

11. The acts described herein which are relied upon to establish invention of the claimed subject matter were carried out in the United States of America, a NAFTA country, or a WTO country.

12. I declare, to the best of my knowledge, that all statements made in this document are true, and that all statements made on the information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-identified patent application or any patent issued thereon.

Dated: 9-26-2007

Name: Madhu Rao

Table of Contents

Frame Relay ELMI Address Registration

This feature module describes the Frame Relay ELMI Address Registration feature and includes information about benefits, supported platforms, related documents, and more.

This document includes the following sections:

- Feature Overview
- Supported Platforms
- Supported Standards, MIBs, and RFCs
- Prerequisites

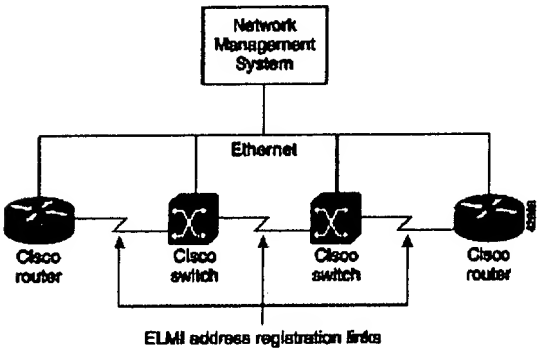
Feature Overview

The Frame Relay ELMI Address Registration feature enables a network management system (NMS) to detect connectivity among the switches and routers in a network using the Enhanced Local Management Interface (ELMI) protocol. During ELMI version negotiation, neighboring devices exchange their management IP addresses and ifIndex. The NMS polls the devices to collect this connectivity information.

Before this feature was introduced, NMS could detect only the topology of routers or the topology of switches. The NMS could not detect router and switch interconnection and was therefore unable to create a complete topology of the network. With the Frame Relay ELMI Address Registration feature, the NMS can detect switch and router interconnection and create an end-to-end network topology map for network administrators.

Figure 1 shows a typical network in which ELMI address registration is in use.

Figure 1: Connectivity Detection Using ELMI Address Registration



The Cisco Frame Relay MIB has been enhanced to support the new ELMI information. The NMS uses the MIB to extract the IP address and ifIndex of devices neighboring the managed device.

Note The ELMI address registration mechanism does not check for duplicate or illegal addresses.

ELMI address registration takes place on all interfaces on which ELMI is enabled, even if all the

interfaces are connected to the same router or switch. The router periodically sends a version inquiry message with version information, the management IP address, and ifIndex to the switch. The switch sends its management IP address and ifIndex using the version status message. When the management IP address of the switch changes, an asynchronous ELMI version status message is sent to the neighboring device immediately.

When ELMI is enabled, the router automatically chooses the IP address of one of the interfaces to use for ELMI address registration purposes. The router will choose the IP address of an Ethernet interface first, and then serial and other interfaces. You have the option to use the IP address chosen by the router or to disable the autoaddress mechanism and configure the management IP address yourself. You can also choose to disable ELMI address registration on a specific interface or on all interfaces.

Benefits

The Frame Relay ELMI Address Registration feature provides an end-to-end networking solution with integrated network management capability. Using the ELMI protocol and an enhanced MIB, an NMS can now detect connectivity among the switches and routers in a network. This new functionality allows for autodetection of the complete network topology.

Restrictions

The following restrictions apply to the Frame Relay ELMI Address Registration feature:

- IGX Switch software must be version 9.3.x or later.
- The following UFM Firmware versions are required: UFMC: ZCB, ZDB, or later; UFMU: YCB, YDB, or later
- The ELMI address registration mechanism does not support IPv6.

Related Documents

- *Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.1
- *Cisco IOS Wide-Area Networking Command Reference*, Release 12.1

Supported Platforms

- Cisco 2500 Series
- Cisco 2600 Series
- Cisco 3600 Series
- Cisco 4500 Series
- Cisco 7200 Series
- Cisco 7500 Series

Supported Standards, MIBs, and RFCs

Standards

No new or modified standards are supported by this feature.

MIBs

Cisco Frame Relay MIB

For descriptions of supported MIBs and how to use MIBs, see the Cisco MIB web site on Cisco Connection Online (CCO) at http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.

RFCs

No new or modified RFCs are supported by this feature.

Prerequisites

ELMI must be enabled on the Cisco router and the Cisco switch.

Configuration Tasks

See the following sections for configuration tasks for the Frame Relay ELMI Address Registration feature. Each task in the list is identified as optional or required.

- Configuring the IP Address to Be Used for ELMI Address Registration (Optional)
- Disabling Automatic IP Address Selection (Optional)
- Disabling ELMI Address Registration on an Interface (Optional)
- Verifying ELMI Address Registration (Optional)

Configuring the IP Address to Be Used for ELMI Address Registration

To configure the IP address for ELMI address registration, use the following global configuration command:

Command	Purpose
`Router(config)#frame-relay address registration ip address`	Configures the IP address to be used for ELMI address registration.

Disabling Automatic IP Address Selection

To disable the automatic selection of the IP address to be used for ELMI address registration, use the following global configuration command:

Command	Purpose
`Router(config)#no frame-relay address registration auto-address`	Disables the automatic selection of the IP address to be used for ELMI address registration.

Note Automatic IP address selection is also disabled when you configure the management IP address using the **frame-relay address registration ip** global configuration command.

Disabling ELMI Address Registration on an Interface

To disable ELMI address registration on an interface, use the following interface configuration command:

Command	Purpose
`Router(config-if)#no frame-relay address-reg enable`	Disables ELMI address registration on an interface.

Verifying ELMI Address Registration

To verify that ELMI address registration is configured correctly, use the following privileged EXEC configuration command:

Command	Purpose
`Router#show frame-relay qos-autosense [interface interface]`	Displays the QoS[1] values sensed from the switch.

1. QoS = quality of service.

Monitoring and Maintaining ELMI Address Registration

To monitor ELMI address registration, use one or more of the following privileged EXEC commands:

Command	Purpose
Router#**show frame-relay qos-autosense** [**interface** *interface*]	Displays the QoS values sensed from the switch.
Router#**debug frame-relay lmi** [**interface** *interface*]	Displays information about the LMI[1] packets exchanged by the router and the Frame Relay service provider.

1. LMI = local management interface.

Configuration Examples

This section provides the following configuration examples:

- Configuring the IP Address to Be Used for ELMI Address Registration Configuration Example
- Disabling Automatic IP Address Selection Configuration Example
- Disabling ELMI Address Registration on an Interface Configuration Example

Configuring the IP Address to Be Used for ELMI Address Registration Configuration Example

The following example shows how to configure the IP address to be used for ELMI address registration. Automatic IP address selection is automatically disabled when the IP address is configured. ELMI is enabled on serial interface 0.

```
interface Serial 0
 no ip address
 encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay qos-autosense
!
frame-relay address registration ip address 139.85.242.195
!
```

Disabling Automatic IP Address Selection Configuration Example

The following example shows how to disable the automatic IP address selection mechanism. ELMI is enabled on serial interface 0. Because no other IP address was configured, the router will share an IP

address of 0.0.0.0 and a valid ifIndex.

```
interface Serial 0
 no ip address
 encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay qos-autosense
!
no frame-relay address registration auto
!
```

Disabling ELMI Address Registration on an Interface Configuration Example

In the following example, ELMI address registration is disabled on serial interface 0. This interface will share an IP address of 0.0.0.0 and an ifIndex of 0. Automatic IP address selection is enabled by default, so the management IP address of other interfaces on this router will be chosen automatically.

```
interface Serial 0
 no ip address
 encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay qos-autosense
  no frame-relay address-reg-enable
!
```

Command Reference

This section documents new or modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.1 command reference publications.

frame-relay address registration auto-address

To enable a router to automatically select a management IP address for ELMI address registration, use the **frame-relay address registration auto-address** global configuration command. To disable automatic address selection, use the **no** form of this command.

frame-relay address registration auto-address

no frame-relay address registration auto-address

Syntax Description

This command has no arguments or keywords.

Defaults

Auto address selection is enabled.

Command Modes

Global configuration

Command History

Release	Modification
12.1(3)T	This command was introduced.

Usage Guidelines

During system initialization, if no management IP address is configured, then the router automatically selects the IP address of one of the interfaces. The router will choose an Ethernet interface first and then serial and other interfaces. If you do not want the router to select a management IP address during system initialization, the **no** form of this command can be stored in the configuration.

When automatic address selection is disabled and an IP address has not been configured using the **frame-relay address registration ip** global configuration command, the IP address for ELMI address registration will be set to 0.0.0.0.

The **no frame-relay address registration ip** command will set the IP address to 0.0.0.0, even when Frame Relay automatic address selection is enabled.

If you configure the IP address using the **frame-relay address registration ip** global configuration command, the IP address you configure will overwrite the IP address chosen automatically by the router.

If you enable automatic address selection after configuring the IP address using the **frame-relay address registration ip** global configuration command, the IP address chosen automatically by the router will overwrite the IP address you originally configured.

Examples

The following example shows ELMI enabled on serial interface 0. The automatic IP address selection mechanism is disabled, and no other management IP address has been configured, so the device will share a valid ifIndex and a management IP address of 0.0.0.0.

```
!
interface Serial 0
 no ip address
 encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay qos-autosense
!
no frame-relay address registration auto-address
!
!
```

Related Commands

Command	Description

frame-relay address-reg enable	Enables ELMI address registration on an interface.
frame-relay address registration ip	Configures the IP address to be used for ELMI address registration.
frame-relay qos-autosense	Enables ELMI on the Cisco router.

frame-relay address registration ip

To configure the IP address for ELMI address registration, use the **frame-relay address registration ip** global configuration command. To set the IP address to 0.0.0.0, use the **no** form of this command.

frame-relay address registration ip *address*

no frame-relay address registration ip

Syntax Description

address	IP address to be used for ELMI address registration.

Defaults

No default behavior or values.

Command Modes

Global configuration

Command History

Release	Modification
12.1(3)T	This command was introduced.

Usage Guidelines

A management IP address configured by using the **frame-relay address registration ip** command will overwrite the IP address chosen by the router when automatic address selection is enabled.

The **no frame-relay address registration ip** command will disable automatic IP address selection and set the management IP address to 0.0.0.0.

If you enable automatic address selection with the **frame-relay address registration auto-address** global command after configuring the IP address using the **frame-relay address registration ip** global

configuration command, the IP address chosen automatically by the router will overwrite the IP address you originally configured.

Examples

The following example shows ELMI enabled on serial interface 0. The IP address to be used for ELMI address registration is configured, so automatic IP address selection is disabled by default.

```
!
interface Serial 0
 no ip address
 encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay qos-autosense
!
frame-relay address registration ip address 139.85.242.195
!
```

Related Commands

Command	Description
frame-relay address reg-enable	Enables ELMI address registration on an interface.
frame-relay address registration auto-address	Enables a router to automatically select the IP address to be used for ELMI address registration.
frame-relay qos-autosense	Enables ELMI on a Cisco router.

frame-relay address-reg enable

To enable ELMI address registration on an interface, use the **frame-relay address-reg enable** interface configuration command. To disable ELMI address registration, use the **no** form of this command.

frame-relay address-reg enable

no frame-relay address-reg enable

Syntax Description

This command has no arguments or keywords.

Defaults

ELMI address registration is enabled.

Command Modes

Interface configuration

Command History

Release	Modification
12.1(3)T	This command was introduced.

Usage Guidelines

ELMI address registration is enabled by default when ELMI is enabled.

Examples

The following example shows ELMI address registration disabled on serial interface 0.

```
interface Serial 0
 no ip address
 encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay qos-autosense
  no frame-relay address-reg enable
```

Related Commands

Command	Description
frame-relay address registration auto-address	Enables a router to automatically select the IP address to be used for ELMI address registration.
frame-relay address registration ip	Configures the IP address to be used for ELMI address registration.
frame-relay qos-autosense	Enables ELMI on a Cisco router.

show frame-relay qos-autosense

To display the QoS values sensed from the switch, use the **show frame-relay qos-autosense** EXEC command.

show frame-relay qos-autosense [**interface** *number*]

Syntax Description

interface *number*	(Optional) Indicates the number of the physical interface for which you want to display QoS information.

Defaults

No default behavior or values.

Command Modes

EXEC

Command History

Release	Modification
11.2	This command was introduced.
12.1(3)T	This command was modified to display information about ELMI address registration.

Examples

The following is sample output from the **show frame-relay qos-autosense** command when ELMI and ELMI address registration are enabled.

```
Router# show frame-relay qos-autosense


ELMI information for interface Serial1
   IP Address used for Address Registration:9.2.7.9 My Ifindex:4
   ELMI AR status : Enabled.
   Connected to switch:hgw1 Platform:2611 Vendor:cisco
   Sw side ELMI AR status: Enabled
   IP Address used by switch for address registration :9.2.6.9 Ifindex:5
   ELMI AR status : Enabled.
               (Time elapsed since last update 00:00:40)
```

The following is sample output from the **show frame-relay qos-autosense** command when ELMI is enabled:

```
Router# show frame-relay qos-autosense

ELMI information for interface Serial1
 Connected to switch:FRSM-4T1   Platform:AXIS   Vendor:cisco
             (Time elapsed since last update 00:00:30)

 DLCI = 100
 OUT:    CIR  64000       BC 50000        BE 25000        FMIF 4497
 IN:     CIR  32000       BC 25000        BE 12500        FMIF 4497
 Priority 0     (Time elapsed since last update 00:00:12)
```

```
DLCI = 200
OUT:    CIR 128000        BC 50000         BE 5100          FMIF 4497
IN:     CIR Unknown       BC Unknown       BE Unknown       FMIF 4497
Priority 0      (Time elapsed since last update 00:00:13)
```

Table 1 describes the significant fields in the output display.

Table 1: show frame-relay qos-autosense Field Descriptions

Field	Description
IP Address used for Address Registration	Management IP address of the DTE[1] interface.
My ifIndex	ifIndex of the DTE interface on which ELMI is running.
ELMI AR status	Indicates whether ELMI is enabled or disabled on the interface.
Connected to switch	Name of neighboring switch.
Platform	Platform information about neighboring switch.
Vendor	Vendor information about neighboring switch.
Sw side ELMI AR status	Indicates whether ELMI is enabled or disabled on the neighboring switch.
IP Address used by switch for address registration	IP address of DCE. If ELMI is not supported or is disabled, this value will be 0.0.0.0.
ifIndex	ifIndex of DCE.
DLCI	Value that indicates which PVC statistics are being reported.
Out:	Values reporting settings configured for the outgoing Committed Information Rate, Burst Size, Excess Burst Size, and FMIF.
In:	Values reporting settings configured for the incoming Committed Information Rate, Burst Size, Excess Burst Size, and FMIF.
Priority	Value indicating priority level (currently not used).

1. DTE = Data terminal equipment.

Related Commands

Command	Description
frame-relay qos-autosense	Enables ELMI on the Cisco router.
show frame-relay pvc	Displays statistics about PVCs for Frame Relay interfaces.

Debug Commands

This section documents the modified **debug** command related to the Frame Relay ELMI Address Registration feature.

debug frame-relay lmi

Use the **debug frame-relay lmi** privileged EXEC command to display information on the local management interface (LMI) packets exchanged by the router and the Frame Relay service provider. To disable debugging output, use the **no** form of this command to disable debugging output.

debug frame-relay lmi [**interface** *name*]

no debug frame-relay lmi [**interface** *name*]

Syntax Description

interface *name*	(Optional) Name of interface.

Defaults

No default behavior or values.

Command History

Release	Modification
12.1(3)T	This command was modified to display information about ELMI address registration.

Usage Guidelines

You can use this command to determine whether the router and the Frame Relay switch are sending and receiving LMI packets properly.

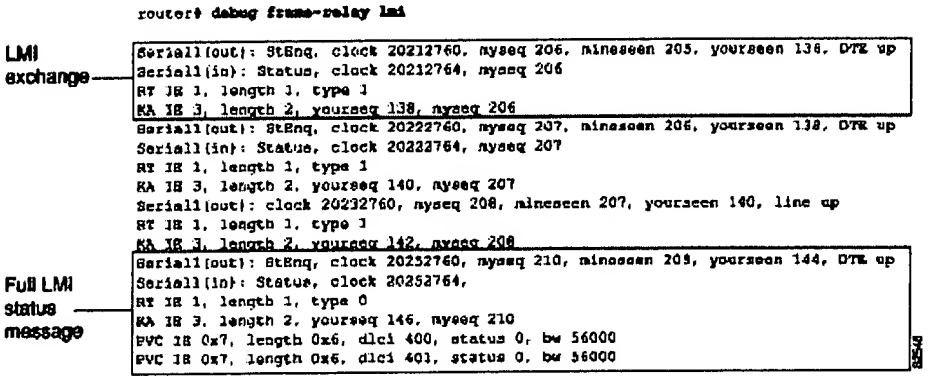
Note Because the **debug frame-relay lmi** command does not generate much output, you can use it at any time, even during periods of heavy traffic, without adversely affecting other users on the

system.

Examples

LMI Exchange Example

The following is sample output from the **debug frame-relay lmi** command:



The first four lines describe an LMI exchange. The first line describes the LMI request that the router has sent to the switch. The second line describes the LMI reply that the router has received from the switch. The third and fourth lines describe the response to this request from the switch. This LMI exchange is followed by two similar LMI exchanges. The last six lines consist of a full LMI status message that includes a description of the two permanent virtual circuits (PVCs) of the router.

Table 2 describes significant fields of the **debug frame-relay lmi** output.

Table 2: debug frame-relay lmi Field Descriptions

Field	Description
Serial1(out)	Indicates that the LMI request was sent out on the Serial1 interface.
StEnq	Command mode of message: StEnq—Status inquiry Status—Status reply
clock 20212760	System clock (in milliseconds). Useful for determining whether an appropriate amount of time has transpired between events.
myseq 206	Myseq counter maps to the CURRENT SEQ counter of the router.

yourseen 136	Yourseen counter maps to the LAST RCVD SEQ counter of the switch.
DTE up	Line protocol up/down state for the DTE (user) port.
RT IE 1	Value of the report type information element.
length 1	Length of the report type information element (in bytes).
type 1	Report type in RT IE.
KA IE 3	Value of the keepalive information element.
length 2	Length of the keepalive information element (in bytes).
yourseq 138	Yourseq counter maps to the CURRENT SEQ counter of the switch.
PVC IE 0x7	Value of the permanent virtual circuit information element type.
length 0x6	Length of the PVC IE (in bytes).
dlci 401	DLCI[1] decimal value for this PVC.
status 0	Status value. Possible values include the following: • 0x00—Added/inactive • 0x02—Added/active • 0x04—Deleted • 0x08—New/inactive • 0x0a—New/active
bw 56000	Committed information rate in decimal, for the DLCI.

1. DLCI = data-link connection identifier.

ELMI Address Registration Example

The following is sample output from the **debug frame-relay lmi** command when ELMI address registration is in use and the data terminal equipment (DTE) has sent a version inquiry message to the date circuit-terminating equipment (DCE). The output specific to address registration is indicated in bold type:

```
elmi3600# debug frame-relay lmi interface hssi 1/0


Frame Relay LMI debugging is on
PVC IE 0x7 , length 0x6 , dlci 304, status 0x2 , bw 64000
ELMI:sending version status_enquiry message
datagramstart = 0x7D991D4, datagramsize = 73
FR encap = 0x00010308
00 75 95 01 01 08 09 3D 0A 63 69 73 63 6F 20 20
20 20 20 20 20 20 20 20 33 36 34 30 20 20 20 20
20 20 20 20 20 20 20 20 33 36 34 30 20 20 20 20 20
20 20 20 20 20 20 01 00 00 00 04 09 02 07 09 00

00 00 00 00 80
```

Table 3 describes the fields relevant to ELMI address registration when the DTE sends a version inquiry message to the DCE.

Table 3: ELMI Address Registration Field Descriptions That Apply When DTE Sends a Version Inquiry Message to DCE

Field	Description
01	Indicates that ELMI address registration is enabled. Possible values include: • 00—ELMI address registration is not supported by the interface. • 01—ELMI address registration is enabled. • 02—ELMI address registration is supported, but the user has disabled the exchange of information.
00 00 00 04	ifIndex of the DTE interface on which ELMI is running.
09 02 07 09	Management IP address of the DTE.

The following is sample output from the **debug frame-relay lmi** command when ELMI address registration is in use and the DCE has sent a version status message response to the DTE. The output specific to address registration is indicated in bold type:

```
        Hssi1/0(in): Status, myseq 1
        RT IE 1, length 1, type 8
        ELMI: packet received on Hssi1/0
        datagramstart = 0x3600854, datagramsize = 72
        FR encap = 0xFCF10309
        00 7D 95 01 01 08 09 3D 0A 63 69 73 63 6F 20 20
20 20 20 20 20 20 20 20 32 36 31 31 20 20 20 20
20 20 20 20 20 20 20 68 67 77 31 20 20 20 20 20
```

```
20 20 20 20 20 20 01 00 00 00 01 01 02 03 04 00
00 00 00 00 80
        ELMI: received version status, version type = Enhanced
cisco           2611            hgw1            1    1.2.3.4
```

Table 4 describes the fields relevant to ELMI address registration when the DCE sends a version status message to the DTE.

Table 4: ELMI Address Registration Field Descriptions That Apply When DCE Sends a Version Status Message to DTE

Field	Description
01	Indicates that ELMI address registration is enabled. Possible values include: • 00—ELMI address registration is not supported by the interface. • 01—ELMI address registration is enabled. • 02—ELMI address registration is supported, but the user has disabled the exchange of information. • 03—Indicates that the DCE has sent an ELMI address registration asynchronous version status message. Asynchronous version status messages are sent when the IP address of the DCE is changed.
00 00 00 01	ifIndex of the DCE interface.
01 02 03 04	Management IP address of the DCE.

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09/921,936	08/02/2001	Madhu Rao	81862P248	8366

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	Oleg Survillo	2142	

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- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 February 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-81* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-81* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 August 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *02/25/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on February 23, 2007 has been entered.

Response to Arguments

2. The declaration of prior invention in the United States filed under 37 CFR 1.131 on February 23, 2007 has been considered but is ineffective to overcome the prior art reference used in the rejection in the Office action mailed on June 10, 2005.

3. The first named inventor of the current application is attempting to show the alleged actual reduction to practice of the invention in this country in order to antedate the reference applied in the last action. Reasons for holding the declaration ineffective to overcome the Cisco Document reference (Cisco Publication: Frame Relay ELMI Address Registration, posted on December 6, 2000) are explained below.

I. FORMALITIES

4. Affidavits or declarations to overcome a rejection of a claim or claims must be made by the inventor or inventors of the subject matter of the rejected claim(s), a party

qualified under 37 CFR 1.42, 1.43, or 1.47, or the assignee or other party in interest when it is not possible to produce the affidavit or declaration of the inventor(s). Thus, where all of the named inventors of a pending application are not inventors of every claim of the application, any affidavit under 37 CFR 1.131 could be signed by only the inventor(s) of the subject matter of the rejected claims. Further, where it is shown that a joint inventor is deceased, refuses to sign, or is otherwise unavailable, the signatures of the remaining joint inventors are sufficient. However, the affidavit or declaration, even though signed by fewer than all the joint inventors, must show completion of the invention by all of the joint inventors of the subject matter of the claim(s) under rejection. *In re Carlson, 79 F.2d 900, 27 USPQ 400 (CCPA 1935)*. See ***MPEP Section 715.04***.

The declaration filed under 37 CFR 1.131 on February 23, 2007 was only signed by one of the two inventors, Madhu Rao. However, no showing has been made on the record that Mr. Rao was the sole inventor of the subject matter claimed. Therefore, the declaration is ineffective.

II. GENERAL CONSIDERATIONS

A general allegation that the invention was completed prior to the date of the reference is not sufficient. *Ex parte Saunders, 1883 C.D. 23, 23 O.G. 1224 (Comm'r Pat. 1883)*. Similarly, a declaration by the inventor to the effect that his or her invention was conceived or reduced to practice prior to the reference date, without a statement of facts demonstrating the correctness of this conclusion, is insufficient to satisfy 37 CFR 1.131.

The affidavit or declaration and exhibits must clearly explain which facts or data applicant is relying on to show completion of his or her invention prior to the particular general assertion that the exhibits describe a reduction to practice "amounts essentially to mere pleading, unsupported by proof or a showing of facts" and, thus, does not satisfy the requirements of 37 CFR 1.131(b). *In re Borkowski, 505 F.2d 713, 184 USPQ 29 (CCPA 1974).*

Applicant must give a clear explanation of the exhibits pointing out exactly what facts are established and relied on by applicant. *505 F.2d at 718-19, 184 USPQ at 33.* See also *In re Harry, 333 F.2d 920, 142 USPQ 164 (CCPA 1964).* (Affidavit "asserts that facts exist but does not tell what they are or when they occurred."). See **MPEP Section 715.07**.

5. On page 2 of the declaration, the applicant states: "Exhibit 1 attached herewith is a copy of screen images from debug sessions that capture the ELMI-AR protocol data in a running session that illustrates aspects of the invention embodied within the product" (lines 3-5). However, there is no clear explanation of what information presented on the debus session images constitutes illustration of aspects of the invention and which images illustrate these aspects.

III. REDUCTION TO PRACTICE

In general, proof of actual reduction to practice requires a showing that the apparatus actually existed and worked for its intended purpose. However, "there are some devices so simple that a mere construction of them is all that is necessary to

constitute reduction to practice." *In re Asahi/America Inc., **>68 F.3d 442, 37 USPQ2d 1204, 1206< (Fed. Cir. 1995) (Citing Newkirk v. *>Lulejian<, 825 F.2d 1581, 3USPQ2d 1793 (Fed. Cir. 1987)* and *Sachs v. Wadsworth, 48 F.2d 928, 929, 9 USPQ 252, 253 (CCPA 1931).* The claimed restraint coupling held to be so simple a device that mere construction of it was sufficient to constitute reduction to practice. Photographs, coupled with articles and a technical report describing the coupling in detail were sufficient to show reduction to practice.). See **MPEP 715.07 III.**

6. On page 1 of the declaration, the applicant states: "I hereby declare that my invention was reduces to practice prior to December 6, 2000. Below stated are activities of myself and Cisco Technology, Inc. regarding the date on which the invention was reduced to practice." (paragraph [3]). The applicant also states: "My invention is embodied in a Cisco router product that implements the ELMI-AR protocol. Prior to December 6, 2000, I developed and tested a working version of the product comprising my invention. Thus, my invention was reduced to practice prior to December 6, 2000" (paragraph [4]). However, the mere allegations provided in the declaration that the invention was actually reduced to practice are not sufficient without proof to support the allegations of actual reduction to practice. In particular, no evidence has been provided to support an allegation that the product comprising the invention was "a working version" prior to December 6, 2000. Therefore, due to a lack of evidence and sufficient explanation of debug session images of the Exhibit 1 provided in this declaration, actual reduction to practice has not been established for the invention prior to the filing of the non-provisional application 09/921,936 dated August 02, 2001.

7. Therefore, the declaration is ineffective to establish actual reduction to practice of the CLAIMED invention.

Specification

8. The disclosure is objected to because of the following informalities:

Paragraphs [0021-0022] provide a description of Figures 3 and 4. However, the reference to each block for Fig. 3 and 4 is unclear. For example, Par. [0021] line 4 reads: "appends address information to a message 300." It is unclear whether the reference number (300) is referring to a message or to a block in Fig. 3.

Applicant is suggested to amend recited paragraph in order to clarify the reference to each block (or step) of Fig. 3 and 4 such as, for example, Par. [0021] line 4 would read: "appends address information to a message, in block 300."

Claim Rejections - 35 USC § 101

9. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 33-48 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

As to claims 33-48, a machine-readable storage medium is considered to be non-statutory subject matter because specification states: "the logic to perform the methods could be implemented by machine readable media, such as electrical, optical, acoustical and other forms of propagated signals (e.g. carrier waves, infrared signals,

digital signals, etc)." (paragraph [0027]). Under 35 U.S.C. 101, signals *per se* are considered to be non-statutory subject matter.

Applicant is advised to amend the specification in order to satisfy the requirements of 35 U.S.C. 101 regarding claims 33-48.

Claim Rejections - 35 USC § 112

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. Claims 3-4, 7-12, 24-25, 27-32, 40-41, 43-48, 56-57, 59-64, 67-68, 71-72, 75-76 and 79-80 recite the limitation "the appended message".

Claim 7 recites the limitation "the router".

Claim 8 recites the limitation "the switch".

There is insufficient antecedent basis for these limitations in the claims.

As to claim 33, it is ambiguous because it is unclear whether the claim is directed to a machine-readable storage medium storing instructions for performing a plurality of operations or a method comprising a plurality of steps. It appears that what is claimed is a machine-readable storage medium comprising method steps, which is ambiguous because a machine-readable storage medium is expected to comprise computer executable instructions for performing the desired steps. If the applicants' intention was to claim a machine-readable storage medium comprising a sequence of instructions,

then computer executable instructions for performing the recited steps should be claimed rather than method steps as presently claimed.

Claims 34-48 incorporate the limitations of claim 31 and also appear to claim additional method steps (e.g. claim 34 has the machine-readable storage medium further comprising a method step), and therefore are rejected for the same reasons.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

13. Claims 1-81 are rejected under 35 U.S.C. 102(a) as being anticipated by Cisco document (Cisco Publication: Frame Relay ELMI Address Registration, posted on Dec. 6, 2000).

As to claim 1, Cisco document shows a system, comprising a local area network management system to manage and configure a network of routers comprising Network Management System (NMS) (page 2, under section Feature Overview and Fig. 1), a wide area network management system to manage and configure a network of switches comprising Network Management System (NMS) (page 2, under section Feature Overview and Fig. 1), and address registration information to be appended to a message sent between a first router of the network of routers and a first switch of the

network of switches over a connection between the first router and the first switch (page 2, under section Feature Overview and Fig. 1).

As to claim 2, Cisco document shows that the address registration information comprises an interface index (page 2, under Feature Overview, line 4).

As to claim 3, Cisco document shows that the interface index comprises a slot number from which the appended message was sent comprising enabling ELMI on the Cisco router and Cisco switch, which configures the slot number in the interface index (under Prerequisites and Table 1).

As to claim 4, Cisco document shows that the interface index comprises a port number from which the appended message was sent comprising enabling ELMI on the Cisco router and Cisco switch, which configures the port number in the interface index (under Prerequisites and Table 1).

As to claim 5, Cisco document shows that the address registration information comprises an Internet Protocol address (under Feature Overview, line 4).

As to claim 6, Cisco document shows that the address registration information comprises spare bytes wherein spare bytes are the last 6 bytes of the address registration information that follow an IP address information bytes (page 18, sample output following Table 3, and Table 4).

As to claim 7, Cisco document shows that the router sends the appended message (page 2 lines 1-5 and page 8 under Usage Guidelines, "...the first line describes the LMI request that the router has sent to ..." & "... you can use this

command to determine whether the router and the (Frame Relay switch) are sending and receiving LMI packets properly ...").

As to claim 8, Cisco document shows that the switch sends the appended message (page 2 lines 1-5 and page 8 under Usage Guidelines, "...the second line describes the LMI reply that the router has received from the switch ..." and "... you can use this command to determine whether (the router) and the Frame Relay switch are sending and receiving LMI packets properly ...").

As to claim 9, Cisco document shows that the appended message is an enhanced local management interface message (page 2 under Feature Overview).

As to claim 10, Cisco document shows that the appended message is sent when the network of switches and the network of routers are first configured (page 2, Fig. 1, "... the first switch and router are first configured and under Prerequisites, "ELMI must be enabled on the Cisco router and Cisco switch").

As to claim 11, Cisco document shows that the appended message is sent when the network of switches or the network of routers has a change in configuration (page 2 under Feature Overview, "... When the management IP address of the switch changes, an asynchronous ELMI version status message is sent to the neighboring device immediately...").

As to claim 12, Cisco document shows that the appended message is sent at a regular interval (page 2, under Feature Overview, "... the NMS 'polls' the devices to collect the connectivity information...").

As to claim 13, Cisco document shows that the local area network management system uses the address registration information to map the network of switches (page 2, under Feature Overview, "With the Frame Relay ELMI Address Registration feature, the NMS can detect switch and router interconnection and create an end-to-end network topology map for network administrators", Table 2, "... yourseen (136) counter maps to the LAST RCVD SEQ counter of the switch...").

As to claim 14, Cisco document shows that the local area network management system configures the network of switches (under Prerequisites, "ELMI must be enabled (configured) on the Cisco switch").

As to claim 15, Cisco document shows that the wide are network management system uses the address registration information to map the network of routers (page 2, under Feature Overview, "With the Frame Relay ELMI Address Registration feature, the NMS can detect switch and router interconnection and create an end-to-end network topology map for network administrators").

As to claim 16, Cisco document shows that the wide area network management system uses the address registration information to map the network of routers (under Configuring the IP address to be Used for ELMI Address Registration Configuration, "... because no other IP address was configured, the router will share an IP address of 0.0.0.0 and a valid ifIndex.").

As to claim 17, Cisco document shows a method, comprising appending address registration information to a message and sending the message between a router of a

router network and a switch of a switch network (pages 2-3, under Feature Overview, and Fig. 1).

Claims 18-32 have similar limitations as claims 1-16, which are directed to switches and routers in the system that makes the interconnectivity including the LAN and WAN. Therefore, claims 18-32 are anticipated by the Cisco document for the same reasons set forth in the rejection of claims 1-16.

As to claim 33, Cisco document shows a machine-readable storage medium tangibly embodying a sequence of instructions executable by the machine to perform a method comprising appending address registration information to a message, and sending the message between a router of a router network and a switch of a switch network comprising enhancing the Cisco Frame Relay MIB to support the new ELMI information and wherein NMS uses the MIB to extract the IP address and ifIndex of devices neighboring the managed device using embedded instructions (pages 2-3 under Feature Overview, and Fig. 1)

Claims 34-48 have similar limitations as claims 17-32, which are directed to a method of appending address registration information to a message, and sending the message between a router of a router network and a switch of a switch network. Therefore, claims 34-48 are anticipated by the Cisco document for the same reasons set forth in the rejection of claims 1-16.

As to claim 49, Cisco document shows a system comprising a switch for appending address registration information to a message and sending the message

between a router of a router network and a switch of a switch network (page 3 under Feature Overview).

Claims 50-64 are directed to a system that has similar limitations incorporating WAN, LAN, NMS, CLI, and ELMI as the system of claims 1-16. Therefore, claims 50-64 are anticipated by the Cisco document for the same reasons set forth in the rejection of claims 1-16.

As to claims 65-80, the devices of a router and a switch that send appended message over a connection that connects the routing unit and the switching unit, have similar limitations as claims 1-16. Therefore, claims 65-80 are anticipated by the Cisco document for the same reasons set forth in the rejection of claims 1-16.

As to claim 81, Cisco document shows a method comprising appending address registration information to a message (under Configuration Examples, "Configuring the IP address to be used for ELMI address registration configuration – The following example shows how to configure the IP address to be used for ELMI address registration. Automatic IP address selection is automatically disabled when the IP address is configured. ELMI is enabled on serial interface 0."), sending the message between a router of a router network and a switch of a switch network (under Feature Overview and Fig. 1), using the address registration information to map the router network from a wide area network management system controlling the switch network (under Feature Overview, "With the Frame Relay ELMI Address Registration feature, the NMS can detect switch and router interconnection and create an end-to-end network topology "map" for network administrators"), configuring the router network

using the wide area network management system (under Benefits, "... using the ELMI protocol and an enhanced MIB, an NMS can now detect connectivity among the switches and routers in a network. This new functionality allows for autodetection of the complete network topology."), using the address registration information to map the switch network from a local area network management system controlling the router network (under Benefits, "... using the ELMI and enhanced MIB, an NMS can now detect connectivity among the switches and the routers in a network. This new functionality allows for autodetection of the complete network topology."), and configuring the switch network using the local area network management system (under Prerequisites, "ELMI must be enabled (configured) on the Cisco switch").

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Oleg Survillo whose telephone number is 571-272-9691. The examiner can normally be reached on M-Th 7:30am - 5:00pm; F 7:30am - 4:00pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Andrew Caldwell can be reached on 571-272-3868. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Examiner: Oleg Survillo

Date: May 23, 2007

Phone: 571-272-9691

ANDREW CALDWELL
SUPERVISORY PATENT EXAMINER

Substitute for Form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(use as many sheets as necessary)*	Application Number	09/921,936
	Filing Date	8/2/01
	First Named Inventor:	Madhu Rao
	Art Unit	2142
	Examiner Name	Lin, Kelvin Y.
Sheet 1 of 4	Attorney Docket Number	81862.P248

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
KL		US-	6,775,373	8/10/04	Stoughton	
		US-	6,753,980	6/22/04	Sakakura et al.	
		US-	6,684,243	1/27/04	Euget et al.	
		US-	6,667,974	12/23/03	Shigeta	
		US-	6,665,713	12/16/03	Hada et al.	
		US-	6,661,785	12/9/03	Zhang et al.	
		US-	6,639,901	10/28/03	Katzri et al.	
		US-	6,567,851	5/20/03	Kobayashi	
		US-	6,560,217	5/6/03	Peirce, Jr. et al.	
		US-	6,457,044	9/24/02	IwaZaki	
		US-	6,418,219	7/9/02	Planelid et al.	
		US-	6,373,853	4/16/02	Yoshida	
		US-	6,230,009	5/8/01	Holmes et al.	
		US-	6,195,329	2/27/01	Kawashima	
KL		US-	5,978,376	11/2/99	Godse et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

Examiner Signature		Date Considered	5/23/07

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SENT FEES OR COMPLETED FORMS TO THIS ADDRESS.

SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

Substitute for Form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Complete If Known	
Application Number	09/921,936
Filing Date	8/2/01
First Named Inventor:	Madhu Rao
Art Unit	2142
Examiner Name	Lin, Kelvin Y.
Attorney Docket Number	81862.P248

Sheet		of	4

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
OS		US-	5,862,083	1/19/99	Tobita et al.	
		US-	5,608,871	3/4/97	Murono	
		US-	5,325,357	6/28/94	Kimoto et al.	
		US-	5,315,705	5/24/94	Iwami et al.	
		US-	5,206,937	4/27/93	Goto	
		US-	5,140,585	8/18/92	Tomikawa	
		US-	4,780,815	10/25/88	Shiota	
		US-	20030219000	11/27/03	Magret	
		US-	20030165140	9/4/03	Tang	
		US-	20020080752	6/27/02	Johansson	
		US-	20020024945	2/28/02	Civanlar et al.	
		US-	20020023174	2/21/02	Garrett et al.	
		US-	20020023160	2/21/02	Garrett et al.	
		US-	20020018489	2/14/02	Ambe et al.	
OS		US-	20020018476	2/14/02	Roy	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

Examiner Signature		Date Considered	5/23/07

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SENT FEES OR COMPLETED FORMS TO THIS ADDRESS.

SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Substitute for Form 1449/PTO

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(use as many sheets as necessary)

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Filing Date	8/2/01
First Named Inventor:	Madhu Rao
Art Unit	2142
Examiner Name	Lin, Kelvin Y.
Attorney Docket Number	81862.P248

Sheet	3	of	4

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
OS		US-	20020016858	2/7/02	Sawada et al.	
		US-	20020013844	1/31/02	Garrett et al.	
		US-	20020012585	1/31/02	Kalkunte et al.	
		US-	20020012345	1/31/02	Kalkunte et al.	
		US-	20020010791	1/24/02	Kalkunte et al.	
		US-	20020009090	1/24/02	Kalkunte et al.	
OS		US-	20020009084	1/24/02	Kalkunte	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

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This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SENT FEES OR COMPLETED FORMS TO THIS ADDRESS.

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Substitute for Form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Application Number	09/921,936
	Filing Date	8/2/01
	First Named Inventor:	Madhu Rao
	Art Unit	2142
	Examiner Name	Lin, Kelvin Y.
Sheet 4 of 4	Attorney Docket Number	81862.P248

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
OS		The ATM Forum Technical Committee, "Integrated Local Management Interface (ILMI) Specification", Version 4.0, af-ilmi-0065.000, September 1996.	

Examiner Signature		Date Considered	5/23/07

*Examiner: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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CISCO SYSTEMS

Document Number : ENG-43435
Revision : C
Author : Madhu Rao
Department : MSABU – IGX Engineering
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Program Manager : Vivek Datar

IP Address / IfIndex Registration Using ELMI protocol on the UFM Card

Software Unit Functional Specification (UFM side)

Project Headline

Enhancement of the ELMI protocol on the UFM for the auto-discovery of the Frame Relay interfaces by the CW2K NMS. This is achieved by support for IP-Address and IfIndex registration on UFM cards and IOS through ELMI.

Reviewers

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Modification History

Revision	Date	Author	Comment
A	[redacted]	Madhu Rao	Initial Draft
B	[redacted]	Madhu Rao	First Revision - Incorporated feedback from various reviewers. Dropped support for IPv6.
C	[redacted]	Madhu Rao	UFM FW release numbers changed. Sync up with IOS side changes in fspec after coding and code reviews.

TABLE OF CONTENTS

Definitions

This section defines words, acronyms etc commonly used in this document.

CW2K	Cisco Works 2000 running on a Workstation. This is a Network Management Station.
CWM	Cisco Wan Manager software running on a Workstation. This is also known as SV+.
WAN	Wide Area Networking
ELMI	Enhanced Local Management Interface with the capability to provide topology discovery. This is a mechanism by which, network (switches) can inform an user (routers/bridges etc.) about the QoS (quality of service) parameters like committed information rate (CIR), Committed Burst (Bc), Excess Burst Size (Be), maximum frame size, PVC priority etc. We are proposing using ELMI to discover the topology for the devices attached to the frame relay cards like UFMC and UFMU on the IGX.
MIB	Management Information Base
UDP	User Datagram Protocol typically used by SNMP.
CLI	Command Line Interface
UFM	Universal Frame Relay Module
IfIndex	Logical interface description uniquely identifying the interface between the devices (routers, switches). With respect to the UFM FW, there are two IfIndex's. One comes from the Router (IOS) side and it is a 4-byte entity. The second IfIndex is the logical interface description of the UFM connection to the IOS and is generated by the UFM FW computed as follows: `Slot * 1000000 + phy_line * 10000 + port * 1`
AR	AutoRoute Protocol used to discover the WAN network by the NMS
CDP	Cisco Discovery Protocol
NNI	Network to Network Interface.
IE	Information Element in ELMI protocol.
Management IP	Internet protocol address used to identify a device in the Internet. In this document it refers to the IP Address which can be used to identify the box in its entity rather than any of the interfaces within that box. For example, IGX may have interface card, which can have IP Address. Management IP address does not refer to these IP Addresses. It refers to the address by which the IGX switch can be accessed. Typically it is the LAN IP Address (`cnflan`) or the Network IP Address (`cnfnwip`) on the IGX.
ILMI 4.0	Integrated Local Management Interface 4.0. ATM Forum specification af-ilmi-0065.000
SWSW	This refers to the Switch Software running the PCC (processor control card) or the NPM (Network Processor Module)
NPM	Network Processor Module and the main controlling card on the IGX platforms. IGX Switch Software runs on this card. NPM is also referred to as PCC or the Processor control card)
FW	Firmware

Audience

This document is intended for the following departments involved in the ELMI/ILMI extensions to provide a mechanism to auto-discover the WAN/LAN networks using NMS software like Cisco Works [redacted] or Cisco WAN manager.

1. IGX Engineering
2. IGX Switch Software
3. IOS implementation group
4. Cisco Works [redacted] Group
5. Cisco Wan Manager Group

1. Introduction

The purpose of this project is to enhance the end-to-end manageability of the IGX for enterprise networks. Currently, the only way to set up connections between two routers attached to UFM cards on the IGX is through a multi step process of setting up the router segment and IGX segment independently. This is because, the NMS does not have any information about the devices attached to the interface cards on the IGX. For example, if a Cisco router is attached to the UFM card, the NMS is not aware of the router attached to it. ELMI has already been implemented between the UFM interface cards and Cisco routers attached to it. This project will provide the capability to exchange the Management IP addresses and logical interface indices (AKA IfIndex) between the Cisco router and UFM interface cards using ELMI protocol as the transport mechanism. The IP address and the IfIndex information of the IGX and Cisco router is made available via SNMP MIB, which can be retrieved by the NMS (CW2K and/or CWM in this case). This will enable NMS to provide enhanced topology and connection management. This document uses the term IP address in the context of Management IP address.

1.1 Purpose

The purpose of this project is to enhance the end-to-end manageability of the IGX for the enterprise networks. Specifically the project will enhance the end-to-end manageability of the IGX between Cisco Routers attached to the UFM cards in the IGX nodes. Detailed requirements for this feature is in reference document – 1 mentioned at the end of this document. (Support for neighbor IP-Address and IfIndex registration on UFM and in IOS through E-LMI, rev 1.1, J0rgen Vos.)

1.2 Scope

The project will enable UFM FW:

1. To pass on the IPAddress/IfIndex of the Cisco Router attached to the UFM port to the SWSW and further to the NMS.
2. To pass on the IP address and IfIndex from the NPM to the Cisco Router.

The UFM FW and the Cisco Router will use the existing ELMI protocol to exchange the IP Address and IfIndex. UFM will exchange the IP Address and IfIndex data with the SWSW using the CBUS or the DBUS commands already in use.

This document describes the interaction between UFM FW and Cisco's Router (IOS) ; between UFM FW and SWSW only.

2. Environment

The feature includes in this project require:

- IGX switch software 9.3.x or later
- UFM Firmware versions available during the time of SWSW release mentioned above. It will be part of the Model-C and Mode-D FW; UFMC: ZAS, ZBC or later UFMU: YAL, YBC or later
- CW2k Version 3.1 or later.
- CWM Version 10.1 or later.
- IOS Version TBD

3. Compatibility

The table below provides all the different revisions, which are required on different subsystems for this feature to work in the IGX network.

Subsystem	Revision / Release
SWSW	9.3.x or later
UFM FW	UFMC: ZAS, ZBC or later UFMU: YAL, YBC or later
IOS	TBD
CWM	10.1 or later
CW2K	3.1 or later

4. Overview

4.1 Auto-discovery problem statement

Currently there is no way to display a complete topology consisting of WAN network and router network. Each can be separately discovered and displayed, but the links connecting cannot be discovered. Thus there needs to be a way to specify what is on the other end of an ATM or a Frame Relay link.

Please refer to Figure-1 for the discussion to follow:

- The NMS software (Cisco Works 2000) can typically discover the IGX WAN Networks independently using the Gateway nodes (igx-1 and igx-4). Other IGX's NWIP addresses typically gets routed through the Gateway IGX node.
- The NMS also discovers the Router network independently using the CDP protocols.
- However there is no way to tie these networks together. This is the main problem that needs to be solved. Specifically from the Figure-1, the links Link-A and Link-B cannot be drawn on the NMS.

4.2 Proposed high-level solution

A. CW2K discovers the router network.
B. CW2K discovers the WAN networks.
C. For each frame relay port or ATM interfaces in the WAN network CW2K reads the ELMI/ILMI MIB, and gathers the ports far end management IP address, and far end IfIndex information.
D. CW2K uses discovered topology information for the router network to reconcile these two pieces of data to draw the links connecting the routers and IGX's.

The rest of the document describes the ELMI specific details part of the proposed solution.

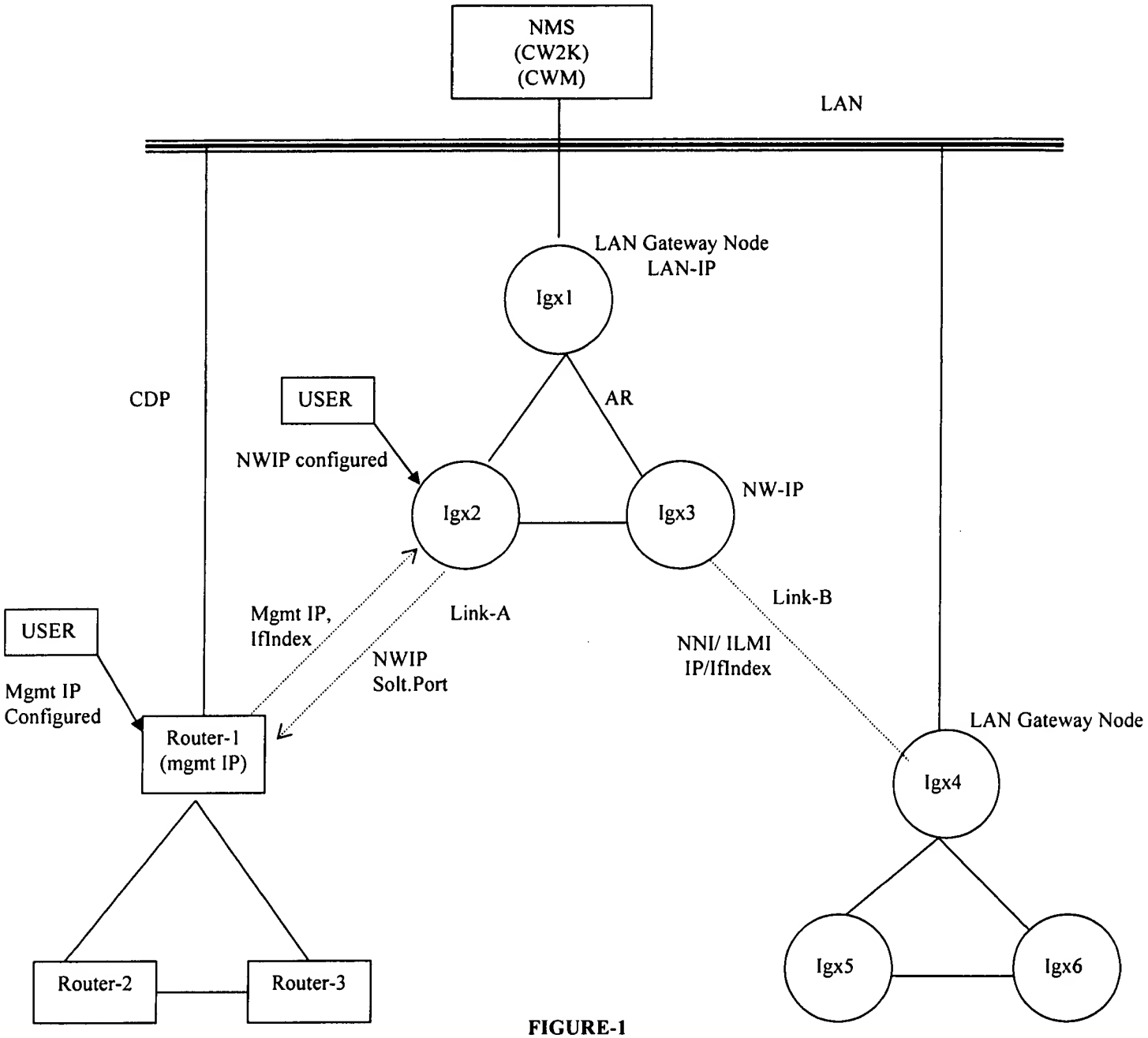
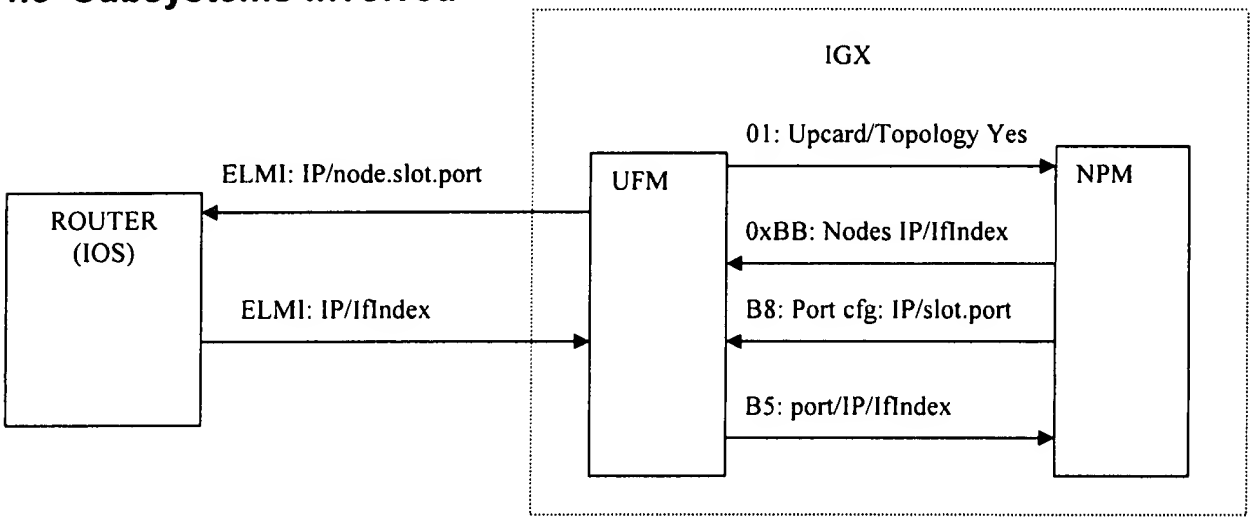


FIGURE-1

LEGEND

AR	AutoRoute Protocol used to discover the WAN network by the NMS
CDP	Cisco Discovery Protocol
- - - -	Desired Discovery implementations (UFM/UXM/IOS)
LAN-IP	LAN IP Address on the IGX Node configured through `cnflan` command
NW-IP	Internal IGX network only IP Address setup through the `cnfnwip` command
NNI	Network to Network Interface.
ELMI	Enhanced Local Management Interface
ILMI	Integrated Local Management Interface 4.0. ATM Forum specification af-ilmi-0065.000
IFINDEX	Logical interface description uniquely identifying the interface between the devices (routers, switches)

4.3 Subsystems involved



Currently ELMI protocol support is already present in the IOS, UFM and NPM.

Whenever the ELMI message is got from IOS side, UFM sends the conditioning report 0xB5 to the NPM SWSW. We will enhance this report to send the IP Address and IfIndex of the IOS side. This will be an asynchronous message to the SWSW.

Similarly, whenever we send the ELMI message to the IOS side, we will embed the IP Address and IfIndex of the IGX node in that message to the IOS side.

4.4 IGX Node IP addresses

4.4.1 LAN IP Address

The LAN IP Address is configured on the IGX using the CNFLAN command and is typically used to connect the IGX on the LAN network. This IP Address will be used by the NMS to extract the MIBs. Typically such IGX's are called as Seed or Gateway nodes since other IGXs in the WAN will route their information through the Gateway.

This IP Address is configured using the command `CNFLAN`.

This functionality is already available in the IGX node.

4.4.2 NWIP Address

This is an internal use-only IP Address and need not be valid IP Addresses in the network. They are used internally. This is an optional IP Address. However for the implementation of the Auto-Discovery features, the user will need to configure the NWIP Address and use the Gateway IGX node to route the information further to the NMS.

The NWIP Address is set using the `CNFNWIP` command.

This feature is also available on the IGX platform.

4.4.3 Management IP Address of the IGX to be passed to the Router through the ELMI interface

NPM card will download the IGX Management IP Address using a new DBUS command with function code, **0xBB**. The NPM SWSW will download this 0xBB DBUS command to UFM FW under the following conditions:

- card rest
- node rebuild
- node switch over
- y-red

The IP Address returned by the NPM software will be as follows:

1. NULL (0) if user did not configure LANIP and NWIP or does not want to publish the IP Address. In case, LANIP is configured this will be published, by default. The IfIndex being sent to IOS side will still be valid, even though the IP address may be NULL.
2. IGX side management IP Address if user allows the IP address to be published through ELMI (set through the `cnftopoaddr` CLI command).

5. Functional Description

5.1 Frame Manager module changes (interface with IOS)

The Frame Manager subsystem implements the LMI and ELMI protocols and will need modifications to support the exchange of the IP Address and IfIndex with the IOS side.

5.1.1 Information Element Changes (ELMI Enhancements)

ELMI is an extension of the LMI protocols and exchanges the QOS parameter modifications and updates. To support the IP Address and IfIndex registration process, the ELMI protocol will be enhanced. There are several Information Elements (IE) in the ELMI implementation. The Version IE has 15 bytes of reserved data, which is not currently used. We propose to use these 15 bytes for IP Address and IfIndex registration process with the Routers (DTE).

The ELMI functional specifications describes in detail the message contents of the ELMI messages, its frequency of exchange between the Routers and the UFM. Please refer to the EDCS documents:
ENG-10297 Frame Relay Enhanced Local Management Interface
ENG-13345 Switch Software Functional Specifications for Enhanced-LMI

5.1.2 Proposed Version IE Layout for IP Address and IfIndex registration

7	6	5	4	3	2	1	0	←Bit Position Octet ↓
Version IE Type Identifier								1
Length of IE (61)								2
0	LMI Version Number				Cisco LMI	ANSI LMI	ITU LMI	3
Device Vendor Name				15 octet string				4 – 18
Device Platform Name				15 octet string				19 – 33
Device Name				15 octet string				34 – 48
						ETOP (2 bits)		**49**
IfIndex (4 bytes)								**50 – 53**
Network Layer Protocol Address (4 bytes)								**54 – 57**
RESERVED (6 bytes) (value 0)								**58 – 63**

New Fields:

Octet 49: Bit 8-3: Reserved.
Bit 1-2: These bits are used for AR status and Asynchronous Version Status message.

The values are
0 0: ELMI AR is disabled on the interface. When this value is received it indicates the router/switch are talking to a device which doesn't support AR.
0 1: ELMI AR is enabled on the interface.
1 0: Valid IP address and Ifindex are configured on the interface, but user disabled exchange of IP address and Ifindex with the neighbor.
1 1: Asynchronous Version Status message, used when the IP address is changed on the switch. Router doesn't use this message.

Octet 49-52: IfIndex Value (If this is ZERO, FW will assume that, the IOS side is not supporting topology discovery feature. Similarly IOS can assume that UFM FW is not supporting topology discovery feature.)
Octet 53-56: Network Layer Protocol Address
Octet 57-63: Reserved:

For each port, the incoming ELMI message will be parsed and the Router side IP Address and IfIndex will be updated internally in the port table. This information will be sent to the NPM via the Conditioning Report (0xB5 DBUS Message).

Similarly, the IP Address and If Index of the IGX will be got by the UFM Card from the NPM SWSW using the function code, 0xB8 and 0xBB DBUS commands and will be passed on to the IOS via ELMI.

Note-1: UFM FW will assume that, the router connected to the Frame Relay interface does not support topology discovery if IfIndex is Zero (bytes 49-52). Similarly, IOS can assume that, the topology discovery feature is not available on the UFM side, if these bytes are zero.

5.1.3 UFM side IfIndex

The IfIndex for the Frame Relay Port is 4 bytes long and is computed with the formula:

```
IfIndex = slot_number * 1000000 + phy_line * 10000 + port*1
```

7	6	5	4	3	2	1	0	←Bit Position Octet ↓
(MSB) IfIndex								1
IfIndex								2
IfIndex								3
(LSB) IfIndex								4

5.2 Admin Module changes (interface with SWSW)

This subsystem is responsible to interact with the

- Frame manager on the UFM Card, using global shared memory. This is when the ELMI data is got from IOS to Frame Manager to Admin module.
- NPM Switch Software using DBUS commands.

Admin Module will need changes in the following Functions Codes to support exchange of the IP Address and IfIndex of the IOS side as well as the IGX Side.

0xB8	Port Configuration message: From NPM to UFM. SWSW will send the UFM-IOS logical connection and IfIndex information.
0xB5	UFM Passes Routers IP Address/ IfIndex from NPM/SWSW
0xBB	New function code being introduced to retrieve the IGX Management IP Address to be sent to the Router.
0x01	The Up Card Event message changes to indicate the Topology discovery capability.

5.3 DBUS messages specifications

The UFM and SWSW communicate with each other using the DBUS fixed format messages. The following DBUS messages are required for exchanging the IPAddress and IfIndex.

5.3.1 Reporting topology discovery capability in an UpCard message

The UFM FW will send the UpCard (0x01) message to the SWSW and this message will be used to report the capability of topology discovery. An existing spare bit will be used for this purpose. The figure below shows the enhanced 0x01 UpCard Message:

Bit Position → Octet ↓	7	6	5	4	3	2	1	0
Message Length	21							
Fn. Code	**Function code = 0x01**							
MB0	8/5 slot cage and card type							
. . .								
MB17	NNI	CGW	FST	PLCN	SIW	ELMI	HSTD	FRIC
MB18	E1T1	V35	X21	HSSI	TGN	BLT	**ETOP**	X
MB19	Frame Buffer Data Size							

ETOP (mb18) is the new spare bit being used and this if set means, UFM FW is capable of discovering topology, using ELMI.

5.3.2 Passing IPAddress and IfIndex of Router from UFM to NPM

The UFM firmware will use **the function code 0xB5** to send the Network IP Address type/length/value and IfIndex of the IOS device associated with the Port on the UFM. The UFMC can have a maximum of 248 logical ports and UFMU has a maximum of 12 physical ports. UFMU Logical port and physical ports are same. This is **an ASYNC Message** being sent from UFM to NPM whenever it detects change in the IP Address and IfIndex of the link to the Router.

The algorithm is as follows:

1. Frame manager (part of UFM FW) receives ELMI message per PORT and passes this to the Admin
2. Admin Module extracts the IP Address and IfIndex of the connection and compares with the internal IP Address and IfIndex associated with the port.
3. If the IfIndex or IP Address information of the IOS side for that PORT is changed, indicate the new IP Address and IfIndex to the SWSW using the 0xB5 message.

5.3.2.1 DBUS Message = 0xB5

The modified version of the 0xB5 DBUS command is specified below:

Bit Position → Octet ↓	7	6	5	4	3	2	1	0
Message Length	**13**							
Fn. Code	**Function code = 0xB5**							
MB0	Slot number of the UFM							
MB1	b0 1=ELMI protocol active 0=No ELMI protocol b1-b3 SPARE b4 Cable Mismatch b5 Overspeed alarm b6 Port configuration has failed b7 LINK is up.							
MB2	Port Number							
MB3	HCH - Hyper Channel							
MB4-MB7	**IfIndex of IOS device attached to the UFM port.**							
MB8-MB11	**Network Address of the IOS device attached to the UFM port.**							

5.3.3 Passing IPAddress and IfIndex of UFM-IOS link by the NPM to UFM

1. SWSW will send a 0xB8 Port Configuration message to UFM FW to download the following:
   - The logical port number of the UFM port.
   - Network IP Address of the device attached to the UFM port as reported by the IOS earlier.
   - The IfIndex of the device attached to the UFM port as reported by the IOS earlier.
2. The message 0xB8 is already being sent part of the port configuration. The 0xB8 will have the line and logical port number information to derive the IfIndex to be sent to the IOS side.
3. The IfIndex being sent to IOS can be decoded as follows:

```
Switch Side IfIndex = Slot * 1000000 + phy_line*10000 + port*1
```

4. When the UFM FW receives this 0xB8 message, it will derive the IfIndex of the IGX and update the IfIndex stored internally for that Port if it is different. Next ELMI message sent to the Router will then update the IfIndex on the Router side.
5. Also part of the 0xB8 message from the NPM contains the IP Address and IfIndex for the device attached to the UFM port. UFM FW will compare this value to the internally stored value and if different, UFM FW will send a 0xB5 message back to SWSW to indicate any changes as described in the previous section.
6. A new DBUS message 0xBB will be sent by the NPM to the UFM with the IP Address of the node.

5.3.3.1 DBUS Message = 0xB8

The modified version of the 0xB8 DBUS command is specified below:

Bit Position → Octet ↓	7	6	5	4	3	2	1	0
Message Length	**15**							
Fn. Code	**0xB8**							
MB0	Physical Line#							
MB1	Port number							
MB2	ECN threshold (MSB)							
MB3	ECN threshold (LSB)							
MB4	RPLY	**ETOP**	SPARE				FECN	BECN
MB5	**Logical Port number of the SWSW. This will be used to derive the IfIndex for the connection with the device connected to the UFM port. It is derived using the formulae:** Slot * 1000000 + phy_line*10000 + lglport*1							
MB6-MB9	**Network IP Address of the device attached to the UFM Port.**							
MB10-13	**IfIndex of the device attached to the UFM Port.**							

5.3.3.2 DBUS Message = 0xBB

Format of the DBUS command = 0xBB is specified below:

Bit Position → Octet ↓	7	6	5	4	3	2	1	0
Message Length	6							
Fn. Code	Function code = 0xBB							
MB0	Slot number of the UFM							
MB1-MB4	IGX Management IP Address							

6. Memory and Performance Impacts

Memory Impact

Additional code changes will be small for this feature enhancement.

The changes will be done on the Admin and the Frame Manager Modules of the UFM Firmware. They share global memory. We can have up to 248 Logical ports on the UFM-C cards.

Assuming Maximum Logical Ports per UFM Card = 255
Each Port will have an IPAddress and IfIndex data structure associated with it for the Remote End Interface. (With the routers)

Size of the IP Address and If Index Registration Overhead = 15 bytes Maximum (We plan to use the 15 unused bytes of the Version IE Structure of the ELMI).

We will be storing this information in a Vector, which will be indexed by the Port Number or the Logical Port Number.

Additional memory impact for the new data would be about 255 * 15 ~ 4K, which is minimal impact.

Performance Impact

There will not be any performance degrades, since we are extracting the additional information from the ELMI messages, which are already being supported. There will be slight overhead in the extraction of the IP Address and IfIndex of the device attached to the UFM Port and comparing this with the internally stored value per port. This overhead is minimal and hence will not have any major impacts.

On the DBUS between the NPM and UFM, the IP Address and IfIndex data will be exchanged infrequently. The IP Address changes of the IGX Nodes will be sent only when there is a configuration change. Similarly, UFM FW will send the IP Address and IfIndex of the device attached to the UFM Port only if it changes. Hence the performance impact due to this is also minimal.

Also if the Router send the ELMI data at a very fast rate due to any reasons, what happens?

As per the original ELMI functional specifications, under these circumstances, the UFM card is still supposed to function correctly as far as data/voice transfer is concerned. This is handled part of the original ELMI functional specifications. Please refer to the ELMI functional specifications. (ENG-10297 and ENG-13345). We are not making any changes in this area.

7. Packaging Considerations

The FW packaging will be as per the standard UFM releases. No new packaging issues are involved.

8. End user Interfaces

From the UFM perspective, there are no direct user interfaces involved. The user interface is a SWSW function.

9. Configurations and Restrictions

1. For the proper use of the ELMI for auto-discovery feature, the user is expected to use the SWSW CLI (`cnftopoaddr`) to set the LAN-IP Address or the Network IP Address and specify which one will be published to the NMS.

2. In case there is no IP Address configured, we expect NPM to send NULL IP Address, which will be sent as NULL to the other end on the UFM. IfIndex will still be valid and sent which will can be decoded as, `Slot * 1000000 + phy_line*10000 + port*1`

3. The UFM FW will make no attempt to validate the IP Address received either from the Routers or the SWSW.

4. Also there is no considerations in this for the support of IPv6. This requires atleast 16 bytes of additional data to hold 128 bit Ipv6 Addressing.

5. Compatibility with the older versions of the UFM FW and SWSW versions, we have introduced a new BIT called as ETOP in the 0x01 Upcard event message. Only if this bit is set, topology discovery will be possible.

10. Testing Considerations

CISCO Router will be connected to the UFM.

ELMI will be enabled on both the UFM and Router Side.

Test Coverage will include the cases, when proper IP Address is configured on the IGX Node the links between the UFM and Router should be discovered on the NMS.

Similarly, if the User Configuration on the IGX node prevents us from publishing the IP Address of the IGX node to the NMS, we will check for NULL IP addresses and proper IfIndex being sent.

Standard UFM regression testing will also be done to check that no other features are broken due to the feature implementation.

11. Risks and Dependencies

This document defines the functional specifications of the UFM Firmware component of the topology discovery project. The other components include the IOS (Router), SWSW and CW2K/CWM NMS.

1. UFM FW has a direct dependency on the IOS component and SWSW components. It cannot be complete without both these complete.
2. SWSW is dependent on the UFM FW completion and CW2K/CWM completion.
3. CW2K/CWM changes will not be complete until IOS changes are in place and SWSW changes are in place.

12. Reliability, Availability, Maintainability and Serviceability

Formal software development process will be used to execute the project.

Formal code inspections, test plans inspections will be done in this project to improve the overall quality and maintainability of the FW.

The ELMI topology discovery feature will not impact the availability of the IGX system.

The ELMI topology discovery feature will not impact the reliability of the IGX system itself. However the feature will be tested under severe failure conditions through the unit-test, dev-test and system test phases to ensure the reliability of this feature.

13. Reference Documents

The following documents were referred for the development of these functional specifications.

1. Support for neighbor IP-Address and IfIndex registration on UFM and in IOS through E-LMI, rev 1.1, J0rgen Vos.
2. Products Requirements Document: Support for Neighboring IP-Address and IfIndex Registration on the UFM and In IOS through E-LMI. There is no document number for this yet. The document revision is 1.2. Document is written by J0rgen Vos.
3. ELMI Software Functional Unit Specifications. ENG-10297
4. IP Address and IfIndex Registration Support through ELMI – Software functional Specifications from the IOS group. Document Number ENG-42300 authored by K.A.N.Srinivas.
5. Functional specifications for the SWSW for the ELMI enhancements for topology discovery. ENG-44272 by Srikanth Hosakote.

14. Attachments

None

No.	Source	File Information
1.	**EDCS** WORD	**ELMI Address Registration Program Plan** *http://wwwin-eng.cisco.com/Eng/Access/4000/Program_Plan/elmiprog_plan.doc* **Status:** DR **Rev:** 1 **Date:** [redacted] **Size:** 117 K **Doc No:** ENG-49176 **Format:** WORD PDF

Document Number	ENG-XXXX (var)
Revision	A (02)
Author	Name of Author
Project Manager	**Amit Phadnis**
Commit Status	[Not] Committed

ELMI Enhancements

Program Plan

Project Headline

This is a program plan for the ELMI Enhancements featurrette, specifically targeting the ELMI Address Registration functionality between Routers and Switches across WAN (FR) interfaces. The objective of this project is to provide end to end topology management functionality to CW[redacted]users.

Reviewers

Departmet	Name and Title
Development Engineering	Chris Hudson, Manager, Software Development (IOS-WAN), Vivek Datar, Manager software Development (IGX Engineering), Robert Verkroost, Manager Software Development, Sri Hosakote, Manager software Development (SWSW)
Dev Test Engineering	Rick King, Manager Software Development, IOS-WAN, Leonard Wu, Software Engineer
Product Mktg	Sanjay Bharadwaj, Product Manager
Manufacturing	
Customer Advocacy	
Compliance	
Impacted Groups	CWM, CW2K

Rev	Date	Originator	Comment
A(01)	[redacted]	Amit Phadnis	Initial Release
A(02)	[redacted]	Amit Phadnis	Changes to section 4.2, section 9

Modification History

Definitions

ELMI	Enhanced Local Management Interface. This is an extension of the FR-LMI so that the switch can communicate the QOS parameters for the configured PVCs to the connected routers. The ELMI enhancement project proposes to support topology discovery for devices attached to IGX over WAN (FR) interfaces.
ELMI-AR	ELMI Address Registration
IfIndex	Unique identification of the interface at the router, directly connecting the router to IGX.
IP Address	Management IP address, identifying the device in the internet.

0 Abstract

This project enhances the current ELMI protocol so that IP address and ifIndex information can be exchanged between the Switch and the Router using it. This will make end to end topology discovery possible for devices directly attached to the Switches over WAN Interfaces.

0 Objectives

The objective of the project is to make topology discovery possible for devices directly attached to the Switches across WAN interfaces. Both ATM and Frame Relay interfaces need to be supported. The ELMI protocol will be enhanced to support the exchange of ip Address and ifIndex information over the Frame Relay interfaces, ILMI would be used to exchange the same information over ATM interfaces. Changes are required on both the Routers (IOS) and the Switches. This project specifically deals with the changes required in the IOS to support the topology discovery function on the Routers. Refer to ENG-45236 for the ELMI/ILMI SWSW changes project plan.

0.0 Project Priorities

The project priority is time to market. The cost is not an issue since this is a software only project. The functional priority is to implement the end to end topology discovery.

0.0.0 Production Standard Costs:

NA

0.0.0 Production Forecast

NA

0.0.0 Software Memory Estimates

This project is not expected to change the memory requirements on the routers significantly. The size of the ELMI messages carrying address registration information would be approximately 70 bytes more than the normal ELMI message, per FR interface on which ELMI is enabled. This is not a significant overhead.

0.0.0 Hardware Memory Options

NA

0 Key project deliverables

Software release for IOS. Current target is 12.1(4)T
For other deliverables related to SWSW and CW2K, please refer to ENG-45236.

0.0 Key Features

Address Registration over Frame Relay interface, between the Switch (IGX-UFM) to the routers. This needs to be achieved by enhancements to the existing ELMI protocol. The address registration would done by exchanging the ip Address and the ifIndex information between the router and Switch. The router might be connected to more than one Switch over different FR interfaces. The Address Registration function would be enabled by default on all the FR interfaces on which ELMI is enabled. The registered address information would be maintained at the router as a part of the FR MIB. The FR MIB would be extended to support the ELMI-AR information.

0.0 Features not supported

Per interface disabling of ELMI-AR would not be supported. Similarly, per interface ip address registration would not be supported. The ip Address registered will be the global ip address of the devices, which may not have any relation to the ifIndex registered. Duplicate address registrations on different interfaces from different or same switches would not be detected. There would be no checks to detect invalid ip address registrations. There would be no exchange of information or processing of information between ILMI and ELMI. No other protocol addresses other than IPv4 addresses would be supported.

0.0 Performance

The Address Registration functionality will not have any significant impact on performance of the Routers or the Switches, since there is a overhead of only 70 bytes at 10 minutes interval for every interface on which the ELMI is enabled.

0.0 Patent Considerations

The Address Registration function using ELMI could be considered for patenting.

0 Development Approach

Although the end objective is to support topology discovery for both FR and ATM interfaces, there are no changes required for supporting the functionality over ATM interfaces. The existing ILMI implementation in IOS will be used. The Router side Address Registration related development would be done by IOS, whereas the switch side functionality would be developed by SWSW. The CW2K functionality would be developed by EMBU.

All the freshly developed code and the changes in the existing code would be 100% code inspected. The Unit tests would be designed to obtain atleast 90% state coverage. The uncovered statements would be specifically analyzed. Since there is no organizational data available at this time, there is no target set for the defect densities for the Code inspection and the Unit Tests. There will be no integration test phase. The integration of this function with IOS and the related integration tests would be done as a part of the Unit testing.

0.0 Product Development Activities Entry/Exit Criteria

The different Phases in this project are:

Functional Specification	: Entry Criteria	: Availability of the PRD
	Exit Criteria	: Review and changes to the FS based on review feedback from at least one of the SWSW, CW2K or CWM groups.
Design Specifications	: Entry Criteria	: Availability of the reviewed and updated FS
	Exit Criteria	: Review and changes to the DS based on review feedback from at least one of the SWSW, CW2K or CWM groups.
Coding	Entry Criteria	: Availability of the reviewed and updated FS and DS
	Exit Criteria	: Code Complete, compiled code
Code Review	Entry Criteria	: Code complete, compiled code

Exit Criteria : Coverage of the 100% fresh code and the changed code.

Dev Test Plan
Entry Criteria : Availability of the reviewed and updated FS and PRD
Exit Criteria : Review of the Dev Test Plan

Unit Testing
Entry Criteria : Code Inspection complete, changes based on code inspection complete.
Exit Criteria : 100% statement coverage, fixing of all the defects found

Dev Test
Entry Criteria : Availability of the SWSW with ELMI related functionality, integration tested. This is an external dependency for start of the Dev tests. Apart from this, the IOS ELMI Unit tests need to be completed.
Exit Criteria : As per the exit criteria set by the Dev Test Group.

0.0 Strategy & Planning Phase Criteria

Please refer to section above.

0.0.0 Code Commit to Mainline Criteria

<Do we need to detail the following three sections, considering the small size of the activity?>

- Zero unresolved sev 1, 2, &3 defects (Entry)
- Test suites automated (Entry)

0.0.0 External Validation Criteria

- External test plans reviewed and approved (Entry)
- Feature and Integration Tests 100% complete (Entry)
- Regression Test complete (Exit)
- System Test complete (Exit)
- Zero unresolved sev 1 & 2 defects (Exit)

0.0.0 Deployment Phase

- FCS Release criteria met (Entry)
- Post Project Assessment meeting (Entry + 3months)

0 Key Development Tasks:

Please refer to section 5.0 of ENG-45236 ver A(05) for the listing of development tasks for this project across different teams. The task with IOS is to enhance the ELMI protocol implementation to support the Address Registration functionality and enhance the FR MIB so that the connectivity information received from the switch could be maintained in IOS and retrieved by the NMS.

0.0 Network Management Tasks

The FR MIB needs to be enhanced to support the Address Registrations received over different interfaces from the Switches.

0.0 Test Engineering Tasks

Refer to section above.

0.0 Diagnostic Development Tasks

NA since no hardware component is involved.

0.0 Mechanical/Power Development Tasks

NA

0 Regulatory Compliance Testing

NA

0.0 Standards

NA since no hardware components are involved.

0.0.0 Y2K Compliance

No specific module identified, which would need special attention for Y2K compliance.

0 **Program Risks and Interdependencies:**
The start of the Dev Tests is dependent on the availability of the Integration tested SWSW code by 3/1/2000 and the required hardware.

0.0 **Resource Contentions:**
None identified at this point in time.

0.0 External Dependencies:
Hardware availability at Cisco Bangalore: One IGX with two UFM cards need to be available at Cisco Bangalore by the start of the Dev Tests, so that issues/defects found during the Dev Tests can be reproduced and tackled by the development team Bangalore. This needs to be ensured by the IGX Engineering team.

The start of the Dev tests is dependent on the availability of the Integration tested SWSW code and the required hardware from IGX engineering team.

0.0 Technical Risks
The end to end topology discovery function would not be tested till the Dev tests for CW2K software, which starts after the start of IOS Dev Tests. Although the CW2K development is quite independent of the IOS development, this may throw up a few surprises if there are interfacing issues between CWM and CW2K. Involvement of the CW2K team in the reviews of the IOS Design Specs should prevent this risk from occuring.

0.0 Schedule Risks
Dependence of start of the Dev Test for ELMI dependent on availability of the SWSW integration test code. Slippage in the SWSW integration test completion schedule would affect the Dev test schedule.

The project relies on components developed by different Bus interworking together. This would depend on the clarity in the definition of the interfaces and consistent understanding and interpretation of the different Functional Specs and Design Specs. Any inconsistencies would throw up surprises at the Dev testing phase. Therefore participation from all the BUs in review of the Functional and Design specs is imerative.

0.0 Cost Risks
NA, since this is a software only project.

0.0 Operational Risks
There are no operational risks identified at this point in time.

0.0 Risk Management

- Success of the project depends on cordination between different Bus:
  Impact : Interworking problems between modules
  Mitigation steps : Participation in FS and DS reviews from all the concerned BUs

- Availability of Switches and Routers for Dev Tests
  Impact : Impact on Dev test schedules
  Mitigation : Plan and regular follow up on availability of Switches and Routers.

0 Exceptions to Development Methodology

No separate Integration Test Plan. This is being done considering the small size of the featurrette.

0 Resource Requirements & NRE:

0.0 Engineering Staffing
Table 0:

Name	Function
Vivek Datar	Project Manager

	Target Release Program Manager
	Hardware Manager
	Hardware engineer
	Product support engineer
Amit Phadnis	Software Manager
Kuruganti Srinivas	Software Engineer
Rick King	Development Test Manager
Leonard Wu	Dev Test engineer
	Diagnostic manager
	Diagnostic engineer
	Mechanical engineer
	DVT engineer
	Compliance Manager
	Telecom Compliance
	Safety Compliance
	EMC Compliance
	Power Systems Engineer
	CAD support
	Simulation support

Table 0: Non-Engineering Project Staffing

Name	Function
	Manufacturing program manager
	Mfg NPI manager
	Manufacturing Engineer, NPI
Sanjay Bharadwaj	Marketing
Max Anderson	SW Documentation contact

	HW Documentation contact
	CA contacts
	Quality contact

Table 1: Engineering Expenses Summary:

Development Expense	Cost
Prototypes	NA
Support equipment expenses	
Capital, test equipment	
Capital, systems	
Agency	
Outside services	
Total	

1.1.1 Prototype costs
NA

Schedule:

The "Commit Plan" dates have the external visibility. These dates never change and are for reference only. The "Forecast" dates are the aggressive dates.

Note: By definition, Milestones are the end dates

MS Project version of Forecast Schedule as Appendix in Attachments.

MILESTONES	COMMIT PLAN	FORECAST	COMMENTS
Strategy and Planning Phase			
t0 First Resources Assigned	[redacted]	[redacted]	Initial discussion on the project
System Functional Spec/PRD	[redacted]	[redacted]	System Functional Specs from different groups ready by this time.
Program Plan			
tcommit Planning Phase Complete (Project Committed) - approves Program Plan and System Functional Spec	[redacted] [redacted]	[redacted] [redacted]	MSSBU Program Plan Ready Initial IOS Program Plan Ready
Execution Phase - Hardware			
Hardware Functional Specification Review Complete			
Prelim EMI Review			
PCB Layout Rev 1			
Fab & Asm Rev 1			
H/W Bring Up Rev 1			
Agency Units Avail.			
EMC Compliance Testing			Allow at least 3 weeks.

NEBS Testing (if applicable)			
Safety Compliance Testing			
Telecom Compliance Testing			
PCB Layout Rev 2			if needed
Fab & Asm Rev 2			if needed
System DVT			
Mechanical DVT			
Execution Phase - Software			
Software Unit Functional Specification Review Complete	[redacted]	[redacted]	
Design Review Complete	[redacted]	[redacted]	
Unit Testing Complete	[redacted]	[redacted]	
Code Review Complete	[redacted]	[redacted]	
Internal Verification			
Test Plan Review Complete			
Test Plan Execution			
Test Coverage and Results Review			
External Validation			
External Test Plan Review			
Begin Early Field Test			
Begin Beta Test			

FCS Readiness Review			
Deployment Phase			
CE Training			
Mfg. Pilot Start			
Agency Approval/NA			
FCS -			
Post Project Assessment			
General Availability			
Global Availability			

References

1. IP Address and Ifindex Registration Support through ELMI. Software Unit Functional Specification.
2. Support for Neighbor IP Address and ifIndex registration on UFM and in IOS through ELMI, by Jorgen Vos

Attachments

As appropriate, examples of forms, log sheets, diagrams, schematics, or other pieces of information used in or generated when carrying out the activities of the document would be identified here and then attached as appendices to the procedure. (If attachments are added, delete this paragraph.). Microsoft Project version of Schedules and tasks diagrams can also be attached here.

Project Documentation Checklist

A checklist is used to identify the documents planned for the project. This will ensure that project team members understand the level of detail expected and the phase it will be available. The Project Review Minutes listed in each section below refer to the meeting minutes of the project review which happen on a regular basis (either Monthly Project Review or Phase review whichever is applicable) during the project life.

2.0 Product Definition

- ___ Product Requirements Document
- ___ System Functional Specification
- ___ Program/Project Plan
- ___ Release Plan (for a release vehicle)
- ___ Project Review Minutes

2.0 Design

- ___ Hardware Functional Specification(s)
- ___ System Packaging Design Specification(s)
- ___ Software Unit Functional Specification(s)
- ___ Software Unit Design Specification(s)
- ___ Design Review Minutes
- ___ Project Review Minutes

2.0 Implementation

- ___ Review minutes of Implementation Phase Entry Criteria
- ___ Feature Test Plan(s)
- ___ Integration Test Plan
- ___ Design Validation Test Plan (DVT)
- ___ System Test Plan
- ___ Code Review Minutes
- ___ Project Review Minutes

2.0 Internal Verification

- ___ Review minutes of Internal Verification Entry Criteria
- ___ Test Failure Identification and Resolution
- ___ Test Results
- ___ EFT Plans
- ___ Beta Plans
- ___ Project Review Minutes

2.0 External Validation

- ___ Review minutes of External Validation Entry Criteria
- ___ EFT Results
- ___ Beta Test Results
- ___ Defect Identification and Resolution logged in DDTS
- ___ Final Documentation
- ___ Release Notes for Outstanding Defects
- ___Deviations written, approved, and Corrective Action Plans in place
- ___ FCS Readiness Review Minutes

2.0 Deployment

- ___ CE Training Complete
- ___ First Article Verified
- ___ ECO completed
- ___ Post Project Assessment

LOG of issues and actions up to commitment

Since monthly status updates are now a separate document, but not really used until after project is committed. A log of actions items and status from previous meetings.i

1. **Status from last meeting**

•

1. **Open Actions**

•

1. **Closed Action**

•

Engineering R&D Review Template

1. Abstract

- *Taken from the original abstract.*

1. Accomplishments

- *Accomplishments toward the goals identified in the previous review*

1. Goals for Next Review

- *Immediate objectives of the upcoming review period that are necessary to meet the project schedule.*

1. Issues and Risks

- *New issues and risks that have become apparent since the last review.*
- *Issues and risks resolved since the last review.*
- *Changes to risk management plans (identification, impact analysis, prioritization, control) since the last review.*

1. Defect Status

- *Software and Hardware bugs classified according to severity for the past months and this month.*

1. Changes to Plan

- *Itemize any changes in deliverables or Entry/Exit criteria from the original project plan.*

1. Schedule Update

- *Current status of significant schedule items.*

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A system, comprising:

a local area network management system to manage and configure a network of routers;

a wide area network management system to manage and configure a network of switches; and

address registration information to be appended to a message sent between a [[first]] router of the network of routers and a [[first]] switch of the network of switches over a connection between the first router and the first switch.

2. (Original) The system of claim 1, wherein the address registration information comprises an interface index.

3. (Currently Amended) The system of claim 2, wherein the interface index comprises a slot number from which the ~~appended~~ message was sent.

4. (Currently Amended) The system of claim 2, wherein the interface index comprises a port number from which the ~~appended~~ message was sent.

5. (Original) The system of claim 1, wherein the address registration information comprises an Internet Protocol address.

6. (Original) The system of claim 1, wherein the address registration information comprises spare bytes.

7. (Currently Amended) The system of claim 1, wherein the router sends the ~~appended~~ message.

8. (Currently Amended) The system of claim 1, wherein the switch sends the ~~appended~~ message.

9. (Currently Amended) The system of claim 1, wherein the ~~appended~~ message is an enhanced local management interface message.

10. (Currently Amended) The system of claim 1, wherein the ~~appended~~ message is sent when the network of switches and the network of routers are first configured.

11. (Currently Amended) The system of claim 1, wherein the ~~appended~~ message is sent when the network of switches or the network of routers has a change in configuration.

12. (Currently Amended) The system of claim 1, wherein the ~~appended~~ message is sent at a regular interval.

13. (Original) The system of claim 1, wherein the local area network management system uses the address registration information to map the network of switches.

14. (Original) The system of claim 13, wherein the local area network management system configures the network of switches.

15. (Original) The system of claim 1, wherein the wide area network management system uses the address registration information to map the network of routers.

16. (Currently Amended) The system of claim 15, wherein the wide area network management system configures the network of routers.

17. (Original) A method, comprising:
appending address registration information to a message; and
sending the message between a router of a router network and a switch of a switch network.

18. (Original) The method of claim 17, further comprising using the address registration information to map the router network from a wide area network management system controlling the switch network.

19. (Original) The method of claim 18, further comprising configuring the router network using the wide area network management system.

20. (Original) The method of claim 17, further comprising using the address registration information to map the switch network from a local area network management system controlling the router network.

21. (Original) The method of claim 20, further comprising configuring the switch network using the local area network management system.

22. (Original) The method of claim 17, wherein the address registration information comprises an Internet Protocol address.

23. (Original) The method of claim 17, wherein the address registration information comprises an interface index.

24. (Currently Amended) The method of claim 23, wherein the interface index comprises a slot number from which the ~~appended~~ message was sent.

25. (Currently Amended) The method of claim 23, wherein the interface index comprises a port number from which the ~~appended~~ message was sent.

26. (Original) The method of claim 17, wherein the address registration information comprises spare bytes.

27. (Currently Amended) The method of claim 17, wherein the router sends the ~~appended~~ message.

28. (Currently Amended) The method of claim 17, wherein the switch sends the ~~appended~~ message.

29. (Currently Amended) The method of claim 17, wherein the ~~appended~~ message is an enhanced local management interface message.

30. (Currently Amended) The method of claim 17, wherein the ~~appended~~ message is sent when the network of switches and the network of routers are first configured.

31. (Currently Amended) The method of claim 17, wherein the ~~appended~~ message is sent when the network of switches or the network of routers has a change in configuration.

32. (Currently Amended) The method of claim 17, wherein the ~~appended~~ message is sent at a regular interval.

33. (Currently Amended) A machine-readable tangible storage medium tangibly embodying a sequence of instructions executable by the machine to perform ~~a method~~ operations comprising:

appending address registration information to a message; and

sending the message between a router of a router network and a switch of a switch network.

34. (Currently Amended) The machine-readable tangible storage medium of claim 33, further comprising using the address registration information to map the router network from a wide area network management system controlling the switch network.

35. (Currently Amended) The machine-readable tangible storage medium of claim 34, further comprising configuring the router network using the wide area network management system.

36. (Currently Amended) The machine-readable tangible storage medium of claim 33, further comprising using the address registration information to map the switch network from a local area network management system controlling the router network.

37. (Currently Amended) The machine-readable tangible storage medium of claim 36, further comprising configuring the switch network using the local area network management system.

38. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the address registration information comprises an Internet Protocol address.

39. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the address registration information comprises an interface index.

40. (Currently Amended) The machine-readable tangible storage medium of claim 39, wherein the interface index comprises a slot number from which the ~~appended~~ message was sent.

41. (Currently Amended) The machine-readable tangible storage medium of claim 39, wherein the interface index comprises a port number from which the ~~appended~~ message was sent.

42. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the address registration information comprises spare bytes.

43. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the router sends the ~~appended~~ message.

44. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the switch sends the ~~appended~~ message.

45. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the ~~appended~~ message is an enhanced local management interface message.

46. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the ~~appended~~ message is sent when the network of switches and the network of routers are first configured.

47. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the ~~appended~~ message is sent when the network of switches or the network of routers has a change in configuration.

48. (Currently Amended) The machine-readable tangible storage medium of claim 33, wherein the ~~appended~~ message is sent at a regular interval.

49. (Original) A system, comprising:

a means for appending address registration information to a message; and

a means for sending the message between a router of a router network and a switch of a switch network.

50. (Original) The system of claim 49, further comprising a means for using the address registration information to map the router network from a wide area network management system controlling the switch network.

51. (Original) The system of claim 50, further comprising a means for configuring the router network using the wide area network management system.

52. (Original) The system of claim 49, further comprising a means for using the address registration information to map the switch network from a local area network management system controlling the router network.

53. (Original) The system of claim 52, further comprising a means for configuring the switch network using the local area network management system.

54. (Original) The system of claim 49, wherein the address registration information comprises an Internet Protocol address.

55. (Original) The system of claim 49, wherein the address registration information comprises an interface index.

56. (Currently Amended) The system of claim 55, wherein the interface index comprises a slot number from which the ~~appended~~ message was sent.

57. (Currently Amended) The system of claim 55, wherein the interface index comprises a port number from which the ~~appended~~ message was sent.

58. (Original) The system of claim 49, wherein the address registration information comprises spare bytes.

59. (Currently Amended) The system of claim 49, wherein the router sends the ~~appended~~ message.

60. (Currently Amended) The system of claim 49, wherein the switch sends the ~~appended~~ message.

61. (Currently Amended) The system of claim 49, wherein the ~~appended~~ message is an enhanced local management interface message.

62. (Currently Amended) The system of claim 49, wherein the ~~appended~~ message is sent when the network of switches and the network of routers are first configured.

63. (Currently Amended) The system of claim 49, wherein the ~~appended~~ message is sent when the network of switches or the network of routers has a change in configuration.

64. (Currently Amended) The system of claim 49, wherein the ~~appended~~ message is sent at a regular interval.

65. (Original) A router, comprising:

a routing unit to send a message to a first switch of a network of switches;

a connection to connect the routing unit to the first switch; and

an interface to append an address registration information to the message.

66. (Original) The router of claim 65, wherein the address registration information comprises an interface index.

67. (Currently Amended) The router of claim 66, wherein the interface index comprises a slot number from which the ~~appended~~ message was sent.

68. (Currently Amended) The router of claim 66, wherein the interface index comprises a port number from which the ~~appended~~ message was sent.

69. (Original) The router of claim 65, wherein the address registration information comprises an Internet Protocol address.

70. (Original) The router of claim 65, wherein the address registration information comprises spare bytes.

71. (Currently Amended) The router of claim 65, wherein the ~~appended~~ message is an enhancement local management interface message.

72. (Currently Amended) The router of claim 65, wherein the ~~appended~~ message is sent at a regular interval.

73. (Original) A switch, comprising:

a switching unit to send a message to a first router of a network of routers;

a connection to connect the switching unit to the first router; and

an interface to append an address registration information to the message.

74. (Original) The switch of claim 73, wherein the address registration information comprises an interface index.

75. (Currently Amended) The switch of claim 74, wherein the interface index comprises a slot number from which the ~~appended~~ message was sent.

76. (Currently Amended) The switch of claim 74, wherein the interface index comprises a port number from which the ~~appended~~ message was sent.

77. (Original) The switch of claim 73, wherein the address registration information comprises an Internet Protocol address.

78. (Original) The switch of claim 73, wherein the address registration information comprises spare bytes.

79. (Currently Amended) The switch of claim 73, wherein the ~~appended~~ message is an enhancement local management interface message.

80. (Currently Amended) The switch of claim 73, wherein the ~~appended~~ message is sent at a regular interval.

81. (Original) A method, comprising:

appending address registration information to a message;

sending the message between a router of a router network and a switch of a switch network;

using the address registration information to map the router network from a wide area network management system controlling the switch network;

configuring the router network using the wide area network management system;

using the address registration information to map the switch network form a local area network management system controlling the router network; and

configuring the switch network using the local area network management system.

Cisco Systems, Inc.
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Patent Case Assignment

CISCO SYSTEMS

P248

PREPARED BY MARY ANN GOLCLASURE / WEIL, GOTSHAL

Date Sent: [redacted]

Number of Pages (including coversheet): 5

PLEASE DELIVER THE FOLLOWING PAGES TO:

Name	**Lester Vincent**
Fax No.	**(408) 720-9397**
Phone No.	**(408) 720-8598**

Attached please find a new Cisco invention disclosure. **It is our No. 2851 (CPOL #78061) and is entitled, "Neighbour discovery using address registration protocol running over ELMI."** Also attached is contact information for the inventors. Please keep us appraised regarding the status of this application. This application should be filed approximately three months from this date.

Please let us know if you have any problems meeting this goal. Thank you.

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Patent Idea Details for Idea #78061

GENERAL INFORMATION

Title: Neighbour discovery using address registration protocol running over ELMI

ID: 78061

Patent No.: ---, ---

URL: [Application No. ---]

Inventors: Madhu Rao (madhurao) and Srikanthkumar Hosakote (shosakot)
More details on these inventors listed below.

Date Entered: [redacted]

Date Modified: [redacted]

Date Filed: ---

Date Issued: ---

Background: Delivering address registration through E-LMI support brings the mid-range IGX switch closer to IOS-based cisco (frame relay supporting) products that are managable through standard Cisco NMS tools. (e.g. CWM) This protocol implemented on IGX switch and IOS platforms allows integrated NMS solution for end-to-end connection management over frame relay.

Summary: Without the implementation of the ELMI-AR protocol on the UFM frame relay card and neighbour Cisco IOS, the only way to setup connection betweeen two routers is a multi-step process: Setting up all layer-3 aspects through IOS cli or appropriate GUI, setting up the IGX UFM-to-UFM frame relay connection using the CWM connection manager or IGX CLI, and setting up an IOS DLCI between UFM and each external router through CW2K (or IOS CLI Needless to say that this complicated, connection setup process is not custo friendly, which is one of the reasons for the very low (3.5) customer satisf scroting of our NMS tools.

Advantages: E-LMI protocol is extended in IOS and in UFM on IGX switch software to make use of the unsed 15 octets of data to exchange the IP Address and IfIndex. Using thie extended ELMI, Peer IP Address registration is provided. This Address Registration information is essential for the NMS to build the peering database and the network map.
IGX switch registers the IOS side, IPAddress and IfIndex of every interface to the UFM frame relay ports.
Both IGX and IOS store this topology information in SNMP comliant MIBs. The NMS tools read this MIB to collect the topology information and to provide end-to-end connection management services.

Cisco Use: Cisco products CWM and CW2K network management solutions will use this ELMI - AR feature to provide complete network discovery and end-to-end provisioning services and make them user friendly.
IOS, UFM FW and IGX Switch Software will all be involved in the feature development. Also the NMS components will be enhanced to make use of this new topoogy information.

Method of Detecting Use: ELMI itself is present in the current shipping products of IOS and UFM fw on the IGX. However ELMI-AR is not implemented yet in any of the shipping products. We expect FCS to happen by the end of this year.

By Other Companies: Please note that, all of our competitors have announced integrated NMS applications, with Nortels/Bay's Optivity being the most threatening to IGX and related NMS business.

Previous Public Use: This feature is currently in DEV TEST since [redacted] (UFM FW, IOS, IGX SWSW and CWM components).

First Written Record Date: —

First Written Record URLs: —

Supporting Docs URLs: http://wwwin-eng.cisco.com/Eng/WAN/IGX/WWW/FW/ufm_fw/elmi-ar.html (New

Notes: —

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REVIEW INFORMATION

Review Progress:

Group Name: SPLOB-MSABU

Users: bhart, gcohen, mtasker, pbucking, sks*

(Review Done)

1 node, 100% complete.

**User sks is a designated reviewer for SPLOB-MSABU. (Other members of SPLOB-MSABU may also review this Idea.)*

This idea has been approved. The status application will not be updated in CPO it has been filed with the US Patent O post-approval information is stored in database. If you have questions, please to contact the patent attorneys.

Reviewers' Comments:

REASON FOR APPROVAL:
As per PAMNS [redacted] PRB mtg. At least 2 aspects should be pursued.
(1) The packet format for this method of neighbor discovery is a clear narrow patent.
(2) Neighbor discovery with sharing of IP address over Frame Relay may be a signigficant (and general) patent.

OTHER NON-CISCO USERS OF THIS INVENTION:
Network vendors that support FR. Also, FR network management tools.

DETECTION OF NON-CISCO USE: [redacted]
Market literature that talks about intelligent network topology mapping or maybe dynamic FR routing.

Designated Reviewer:

Manager List: chambers, gmattevi, gpack, kjkenned, listwin, mydo, rmarinco, sks, slyall, smarshal, s

Admin Flags:

Needs edit	☐
Done approval	☑
Rejected	☐
Publicly viewable	☐
Active	☑
Discarded	☐

[redacted]

This Idea data was generated on [redacted] 16:52:36 PDT [redacted] and is available on-line from CPOL at http://wwwin-eng.cisco.com/pcb/cpol/patent.cgi

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